Proceedings of the 11th Health Informatics in Africa Conference

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PART I
Case Studies and Experience Papers

Harnessing the potential of Digital Health Technology to build hardened, sustainable and learning health systems

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Editorial to the HELINA 2018 proceedings

The HELINA 2018 Conference

The 11th HELINA (HEaLth INformatics in Africa) conference was organized from 3 to 5 December 2018 in Nairobi, Kenya. The conference was hosted and organized by the Kenya Health Informatics Association (KeHIA). HELINA 2018 was co-located and held back to back with the popular OpenMRS implementers meeting. The conference focused on how technology is used to strengthen health systems in the African region. Issues of specific interest included the development and implementation of integrated e-Health plans and policies that enable capacity building for eHealth professionals, improving quality of health information and promotion of the meaningful use of health data to support and ground decision-making, improving access to essential medical supplies through improved supply chain and logistics, development of sustainable health information systems for service delivery and innovative health financing models that improve access to health. The role of digital health in health surveillance systems particularly due to emerging health threats including Non-Communicable Diseases, and therefore, the core participatory role of the client in detection, response, treatment and care. Special attention will be paid to the role of e-Health in achieving the Sustainable Development Goals (SDG) voted by the UN in September 2015 and more specifically to goal 9, target 9c which aims to "*Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in the least developed countries by 2020".*

The Conference Themes

The call for submissions for HELINA 2018 covered a broad range of health informatics topics with relevance for Africa under the title "Harnessing the potential of Digital Health Technology to build hardened, sustainable and learning health systems". Academic research papers, work in progress papers, and case study/experience papers where solicited within the following themes:

- National and Regional e-Health Strategies and Policies
- Health Information Systems Interoperability
- Continuous Quality Improvement and use of health data and systems
- Human capacity building for e-Health
- Application of technology in supply chain management
- Sustainable ICT-solutions for health service delivery
- Technology enabled health financing

Submissions of papers that fell outside any of these themes were also acceptable as long as they demonstrated any relevance for the health informatics domain in Africa.

Review process

After a call for papers was sent out a total of 76 submissions were received. A double blind peer review process was used for evaluating each paper. All submissions were anonymized before being submitted to at least 2 reviewers according to their expertise. The SPC chairs based their final decision on the acceptance of each submission on the recommendations and comments from reviewers. Accepted submissions were then sent back to the authors for revision according to the reviewers' comments. This review process resulted in the following acceptance rates:

Full research papers: 16% (n=12)
Work in progress papers: 8% (n=6)
Case studies and experience papers: 43% (n=33)
Rejected or retracted papers: 33% (n=25)

In order to be included in the conference proceedings, an accepted paper had to be presented at the conference. Presentations at the conference indicated that a lot of work is being done towards harnessing the potential of technology systems to build sustainable health systems.

Nicky Mostert
HELINA 2018 SPC Chair

Journal of Health Informatics in Africa

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Approaches in Implementing Personal Health Records in Developing Countries

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Abstract. In the developed world, Personal Health Records (PHRs) have been demonstrated to improve patient adherence, reduce medical errors, improve patient-provider communication, improve chronic disease management, and promote behavior change. Unfortunately, PHRs have not been widely adopted in low- and middle-income countries (LMICs). Several key developments now make it highly feasible to implement integrated PHRs in LMICs. There is increased use of mobile health technology, especially of smartphone-based devices. Chronic diseases that require long term monitoring are on the rise. There is increased adoption of national-level electronic record systems to which the PHRs can be tethered. Further, historical perceptions on acceptance of technology are being shattered and policies that previously constrained PHRs use are being challenged. This paper takes a comprehensive look at factors relevant to successful implementation of PHRs in LMICs, and outlines evidence, policy, technological, user and sustainability considerations relevant to actualizing widespread PHRs adoption in LMICs.

Keywords: Personal Health Records, Mobile Health Technologies, Low- and Middle-Income Countries

1 Introduction

Personal Health Records (PHRs) are "electronic applications used by patients to maintain and manage their health information in a private, secure, and confidential environment."[1] Two important characteristics of PHRs, as defined by the National Alliance for Health Information Technology, are the ability to draw data from multiple sources and to conform to nationally-recognized interoperability standards [2]. However, the key to PHRs is that they are managed, shared and controlled by the individual.

In developed countries, evidence exists that PHRs can improve patient adherence to medications, reduce medical errors, improve patient-provider communication, improve chronic disease management, and promote behavior change [1,2]. Multiple approaches have been used for implementing PHRs with varying degrees of success. The literature describes three predominant models of PHRs implementations, namely: (1) Stand-alone PHRs which are not connected to other data systems; (2) Web-based PHRs that are accessible via online portals; and (3) Integrated PHRs which are generally connected to Electronic Health Record Systems (EHRs)[1].

In general, Integrated PHRs show greater benefits when compared to other types of PHRs. Some of the classical key functions that are usually part of PHRs include the ability to provide the following: (a) access to patient's clinical information; (b) an organized summary of personal medical information for presentation to healthcare providers; (c) a portal to patient-specific consumer-level healthcare information;

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(d) interpretive information on diagnostic test results; and (e) a database of information for patient-specific self-monitoring and disease management [4]. In developed countries, PHRs are widely accepted and used. In fact, in the US, it is estimated that upwards of 75% of patients will have adopted some form of PHRs by 2020 [4]. However, common platforms for PHRs used in the west, such as Google Health or Microsoft,[5] might not be easily adaptable within low- and middle-income countries' (LMICs) constraints.

In this paper, we explore the status of PHRs use in LMICs. We highlight the opportunities that are emerging for PHRs adoption, given the rapidly evolving technology landscape, and also provide a framework to guide PHRs adoption for LMICs.

2 Historical Challenges to PHRs Adoption in LMICs

Unlike in developed countries, PHRs are yet to be widely adopted in LMICs, and this is due to a number of historical reasons. For a long time, PHRs relied on availability of desktop computers and internet-connectively that were largely unavailable to individuals in LMICs. Developing Integrated PHRs (connected to EHRs) was also practically impossible, given that EHRs were not in wide use, with most places primarily using paper-based records. A strong paternalistic culture and hesitation by providers to share information about clinical notes and diagnostic test results and findings also made it challenging to avail clinical data to PHRs. Further, low literacy rates among various patient populations limited their likelihood of using PHRs.

For a long time, policy constraints affected PHRs adoption. In many settings, ownership rights to a patient's medical records still remains contested, with conflicting and/or restrictive policies related to whether clinical records can be availed to PHRs for patient's use. As an example, in several countries, there are regulations that restrict medical records from leaving the care facility where the clinical data was collected, discouraging broad dissemination of clinical data even when the data is collected electronically. Gaps are also evident in emerging national Health Information System (HIS) policies and strategies as these have largely ignored providing guidance on PHRs.

3 New Opportunities for PHRs in LMICs

It is often stated that 'there is no healthcare without information', and this includes ensuring that individuals have relevant information needed for their care. PHRs offer one of the greatest opportunities to disrupt clinical data systems use within LMICs, potentially forming the backbone for care data systems in these settings. Patients have better outcomes if they are empowered to self-manage their conditions and PHRs provide this empowerment [3].

Several factors and recent developments make it an opportune time to implement PHRs in LMICs. With increasing ownership of mobile devices, especially with smartphones and tablet devices that have advanced computing and communication capabilities, many individuals in LMICs now essentially have a tool in hand that can support sophisticated PHRs applications. Smartphone use in LMICs has doubled in the last few years, driven by falling prices and ownership is predicted to rise over 50% by 2020 [4]. Mobile Personal Health Record systems (mPHRs), implemented as applications (Apps) within smartphones, will enable patients to access their medical records, track personal data, communicate with providers, access educational materials, and locate facilities, among other features.

Beyond a more conducive technology environment for PHRs, previously perceived societal barriers to technology adoption in LMICs are also being proven wrong. In many countries, there is widespread success of mobile money and texting modalities, even in populations previously perceived as largely uneducated or shy to technology. The seriousness with which mothers keep pregnancy records documented through antenatal cards, and immunization records for their children, testifies to the fact that individuals in LMICs value record keeping and can be guided to keeping PHRs. Obviously, in some of these cases, patients are still more inclined to keep these records if encouraged by authority figures (such as the providers) to do so. This is already being observed in cases where providers ask their patients to track particular clinical parameters, such as blood sugar levels at home.

Integrated PHRs are also now a possibility given that LMICs are increasingly using EHRs. Multiple countries have deployed or are in the process of deploying nationally-endorsed EHRs. In addition, policy barriers that could hinder acceptance to PHRs are starting to unravel. We are already seeing Ministries of

Health accepting forms of PHRs through short messaging services (SMS) that directly provide information to patients. The increased acceptance of national health data warehouses, that require transmission of patient-level data from primary sources to warehouses, further helps to alleviate resistance to sharing records beyond facilities where the data was collected.

4 An Agenda for PHRs in LMICs

Even with well-defined approaches for introducing PHRs in LMICs, several key factors need to be systematically addressed to assure successful use over time. Below, we outline five key areas to be considered, namely: Research & Evidence; Policy; Technology; Users and Sustainability.

4.1 Research & Evidence:

Oftentimes, technology interventions are implemented without the relevant evidence to support their use. The evidence for the benefit and costs of PHRs in LMICs is still lacking. An evaluation agenda for PHRs within LMICs should include, among them, the following evaluations: (a) perceptions, attitudes, feasibility and acceptability of PHRs by individuals, providers and policy-makers; (b) analysis of availability and cost of relevant technologies and infrastructure for PHRs and an understanding of evolutions of this technology as relevant to PHRs; (c) socio-technical, literacy and cultural considerations in PHRs implementation within LMICs; (d) assessment of impact of PHRs for particular disease domains and care outcomes; and (e) ethical and equity considerations in use of PHRs with LMIC settings. An example of an effort to narrow the evidence gaps comes from an on-going study entitled "The role of Mobile Personal Health Records for Chronic Disease Care in Low- and Middle-Income countries" being conducted by a Moi University and Vanderbilt University Medical Centre Team (Moi University Institutional Research & Ethics Committee Approval #1999 and Vanderbilt University Institutional Review Board Approval #171769). The evidence-base for PHRs would be boosted were there focused interest by funders to support research and evaluations for this potentially disruptive technology application.

4.2 Policy

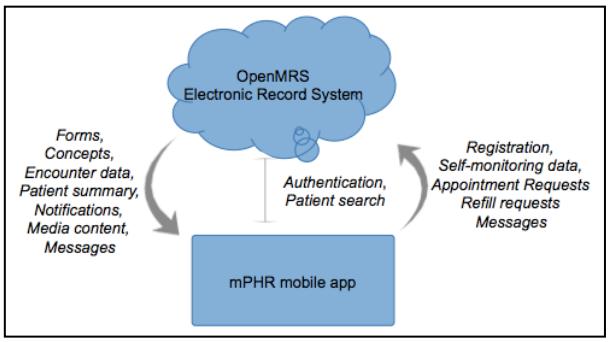
It is clear that LMICs need guidance on the best policies and strategies to implement PHRs. Health information policies that restrict data sharing need to be reviewed given the recognized benefits of health information exchange. The fundamental question of "who owns the patient health data?" still needs to be addressed in several countries. In the US for example, the HIPAA Privacy regulation gives patients the right to access their information under 45 CFR 164.524 and the right to amend it under 45 CFR 164.526 [6]. Even in countries where 'ownership' remains within the prevue of providers or Ministry of Health, it would be feasible to give patients the right to access and modify relevant information on some elements of their medical records. For appropriate policy-making, decision-makers likely need to be educated on PHRs and its emerging role in patient care. Leading organizations, such as the World Health Organization, can also work within their mandate to advance the PHRs agenda.

4.3 Technology

Given that Integrated PHRs provide the most benefit, it is highly recommended that emerging PHRs within LMICs work towards integrating with EHRs, especially with EHRs that are nationally-endorsed. Figure 1 provides an example of how countries (like Kenya, Uganda and Mozambique) that are implementing a commonly used EHRs, OpenMRS, can leverage mPHRs integrated with their national systems to support patients. While mPHRs hold great promise for PHR adoption in developing countries, PHRs can also leverage web-based and SMS-based modalities where appropriate. With limited connectivity, PHR solutions should be able to work in an offline mode, and have configurations that permit downloads to only via Wi-Fi networks to save of data costs. Smartcards with patient data also provide another modality for sharing personal records.

As much as possible, PHRs should use standard terminology and vocabulary that will allow for semantic interoperability with other systems. Clinical messaging and data exchange standards should also be adopted as is appropriate to countries. These PHRs have to be ready to take advantage of interoperability layers and emerging master patient, facility and provider lists as these continue to mature within LMICs. Communication between the PHR and the EHRs has to be secure, either using https-based mechanisms, virtual private networks and encryption of data both during transmission and for storage. As is standard practice, it would be recommended to require user authentication for access of sensitive health content, with automatic logouts on switching between applications or after the user is idle for a predetermined period. Approaches for authentication that use other modalities to accommodate individuals who cannot read and write, such as biometric authentication modalities, could help with uptake.

Figure 1. Integration of mPHRs mobile app with the OpenMRS medical record system.



4.4 Users

An approach to implementing PHRs in LMICs must leverage user-centered design, and incoporate direct end-user engagement to enable appropriate identification of functionality that would be most relevant for patients. Specific design principles should also consider the potential for users sharing phones, and the need for surrogates or guardians to manage PHRs for those with the inability to do so. Literacy rates will also dictate what messaging modalities should be adopted within PHRs. Beyond using text-based approaches, graphics and other forms of audio and video-based media will likely play a significant role in PHRs within LMICs.

4.5 Sustainability

It is now well-recognized that technologies implemented without a sustainability model can easily fail. Naively implementing PHRs that increase costs to users will likely lead to limited use, unless the benefits of the PHRs are obvious. As such, approaches to sustainability need to be critically considered at the outset. Potential models to assuring sustainability of PHRs include having service providers and insurance companies support adoption of these technologies to facilitate education and preventative services, with the goal of reducing costs to care over the long term. Mobile operators might also find value in supporting PHRs, if these systems offer them components that can be leveraged for profit – e.g. access to data for analytics or an opportunity to provide telehealth services for which nominal fees can be charged. Facilities, such as pharmacies, might want to be included in location-based facility finders, and might be willing to pay for other value add services that could be part of PHRs. At the end of the day, PHRs offer an appealing use case for public-private partnerships, providing an opportunity to assure sustainability in settings that would otherwise have limited resources.

5 Conclusion

A convergence of factors makes this an opportune time to implement PHRs in LMICs. Particularly relevant to PHRs adoption is the increased adoption of smartphone and mobile-based technologies that have access to the internet. Implementation of PHRs, especially through mPHR, promises to be a highly disruptive technology, and deliberate strategies are needed to ensure that the most benefit can be achieved from them.

Clear evaluation, policy, technology, sustainability and user considerations are key to realizing the potential of PHRs in LMICs.

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Closed loop for iCCM & HIVST referrals and follow-up: A case study in Kenya

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Introduction: While the Kenya Health Sector Referral Strategy1 proposes the use of Information and Communication Technologies (ICTs) and other strategies to strengthen referrals between Community Health Volunteers (CHVs) and local facilities, many of these strategies have not been widely implemented. As part of Integrated Community Case Management (iCCM) of malaria, pneumonia, diarrhea and malnutrition, CHVs with the aid of paper-based referral notes, verbally refer clients with severe illnesses to link health facilities. Nevertheless, community health data systems do not track and verify whether: i) Client went to facility ii) Client was served at facility or, iii) What the outcome of the referral was iv) if any follow-up is required v) whether the follow-up was done. Also, inadequate uptake of testing services for Human Immunodeficiency Virus (HIV) remains a primary bottleneck towards universal access to treatment and care of HIV/AIDS. CHVs in Kenya provide counselling on healthy living for people with HIV and prevention, in addition to distributing condoms. In this regard, Living Goods and Medic Mobile, with funding from The Bill & Melinda Gates Foundation, endeavors to study the use of ICTs to closely monitor referrals between CHVs' household assessments and health facilities to ensure CHV referred cases are prioritized for treatment, and a counter-referral for follow up to CHVs is actualized and confirmed via verifiable digital data. The study will also seek to establish protocols for distribution of HIV Self-Tests Kits (HIVST) via CHVs in a way that benefits clients and helps governments to accelerate the uptake of HIV Testing Services (HTS).

Methods: The study will take place in Kisii County, Bomachoge Chache (Ogembo) Sub-County. Based on projections of the Kenya Demographic and Health Survey (2014), there is an average of 5 people per household and an estimated population of 111,687 in Ogembo, as at 2017. The study targets household members, CHVs, Community Health Extension Workers (CHEWs), HIV Testing Services providers and health facilities within a select area covered by 6 Community Units (CUs). The study location has approximately 7200 households who are supported by 69 currently active CHVs. This translates to an estimated population of 36,000. Using a Randomized Control Trial (RCT) design, we will randomize the study population at the CHV level, whereby in one arm a digitalized referral system will be deployed, while in the other the status quo (paper-based verbal referral) is maintained. Each arm of the study will have an equal number of CHVs. To manage any negative effects of social interaction between the treatment and control groups, we will double randomize to ensure accurate estimation of the treatment effects. The study will run from April 2018 to June of 2019.

Objectives:

1. Develop a manageable closed loop referral system aligned with the health facilities' iCCM workflows and systems in a way that will not add undue work or complexity.
2. Embed an automated referral and counter-referral process that allows the health facility to notify the CHV that care was sought by a referred client and/or ask them to follow-up, hence ensuring that:

[1] Ministry of Health Kenya. (2013). Referral Strategy and Investment Plan for Health Services – July 2012 – June 2017. Nairobi: Technical Planning and Monitoring / Coordinating Departments.

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   a. 100% of referrals are confirmed via verifiable digital data instead of unreliable self-reported data;
   b. 85% of clients referred are seen at the facility;
   c. 85% of CHVs conduct the necessary follow-up with referred clients.
3. Contribute to a percentage increase in clients tested for HIV and percentage increase in HIV clients receiving ongoing treatment and care. Whereby:
   a. Uptake amongst first time testers is increased by at least 20%, and
   b. At least 90% of the positive screen tests are linked to the facility

Lessons: The findings and insights from this study will be instrumental in demonstrating the viability of a community-based technology supported system for referral linkages and follow up of iCCM cases and HIV Testing Services. Successful test results have the potential to provide a systemic breakthrough in how healthcare is delivered in the developing world via Community Health Workers.

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Use of EMR for Non-Communicable Disease (NCD) Data Entry at Butaro Hospital

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Introduction and setting: Butaro Hospital is a rural district hospital located in the Northern Province of Rwanda. Partners in Health Rwanda, known locally as Inshuti Mu Buzima (IMB) is an NGO supporting Butaro hospital and 45 other government health facilities in three districts. IMB provides training, protocols, socio-economic support, mentorship, and systems to improve patient care. In most facilities, paper-based records are transcribed into an electronic medical records (EMR) system after the clinical visit enabling billing, evaluation, process improvement, and research.

Objectives: IMB has implemented an OpenMRS-based EMR for clinics covering HIV, oncology, cardiac issues, asthma, and diabetes. Hospital leadership requested IMB to adapt EMR for point of care in order to decrease paper usage and improve data use as well as data quality.

Implementation and Lessons Learned: EMR was updated with forms and reports so that in each of the NCD clinics a patient may have an intake form, visit form, special event forms, missed visit call log, and exit form. Before each clinic day, a report listing the data of patients to be seen was generated. Specific to oncology, order sets for chemotherapy regimens were pre-created with dosages by clinical protocol. An indicator report provided data by program, period and location.

The oncology implementation and change management process included a mixed specialty planning team, all-team meetings, staff training, downtime prep, and a final walk-through. Planning involved a multidisciplinary team including clinical leaders, doctors, nurses, nurse educators, software developers, EMR coordinators, and executive leadership. Staff training included system operation as well as quick guides and tips to speed up the work.

A challenge was integration of the EMR outpatient forms with paper inpatient forms. To prevent errors, cover sheets listed visits in EMR that were not in the paper chart.

During EMR charts review some patients appeared to have documents from other patients. The issue was reported to the coordinator who involved the software developers. During re-coding, the coordinator implemented a work-around of naming each attachment uniquely.

Post-implementation, EMR at the point of care ended paper chart loss, integrated physician and nursing documentation, and connected hospital and health center records. Nurses also spent 3 days less per month on indicator reporting.

Butaro EMR uses OpenMRS Platform 1.9 running on Ubuntu and OpenMRS Sync 1.3 for backup and data distribution. The system is running on a hospital server and accessed over the local network on laptops which function as uninterruptible power sources—avoiding the need for consistent internet or power.

Conclusion: EMR for point of care can be adopted in rural area, improve reporting, and integrate clinical reference with appropriate leadership, implementation planning, multidisciplinary team collaboration, staffing, and issue resolution.

Keywords: Electronic Health Records. D057286, Noncommunicable Diseases. D000073296, Global Health. D014943, Neoplasms. D009369, Diabetes Mellitus. D003920, Hospitals, Rural. D006780

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Opportunities for mobile based health financing products for East Africa's long distance truckers

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Introduction: The East African Community's (EAC) Common Market Protocol facilitates movement of people, goods and capital across the six EAC countries. The movement of people increases the need for trans-national healthcare access and portable healthcare financing products that allow for access to health services across borders. Long distance truckers (LDT) spend extended periods of time away from home and are at increased risk of both participating in risky behaviors and needing health care outside of their home countries. Similar to other products and services, healthcare financing solutions require consumer information to better profile and target consumers and design products that meet consumer needs.

Study Objectives and Methods: The United States Agency for International Development funded Cross-Border Health Integrated Partnership Project (CB-HIPP) conducted a study to generate evidence on mobility, health care seeking and health financing behaviors, and mobile phone use at cross-border areas targeting LDTs and other groups. CB-HIPP collected the data to inform the design of healthcare financing products that meet the mobility requirements of LDT crossing East African borders.

CB-HIPP collected data from 361 LDT through structured individual surveys between November 2016 and February 2017. LDT were recruited at cross-border points at three cross border areas: Malaba Kenya-Malaba Uganda, Holili Tanzania-Taveta Kenya, and Gatuna Rwanda-Katuna Uganda.

Lessons learned: 75% of LDT reported more than 20 work trips in the past year with a median duration away from home of 1.5 weeks. One in five LDT reported incurring health expenses while on their current road trip of whom 49% incurred expenses outside their home country. 85% of all LDT that incurred a health expense reported paying out-of-pocket (OOP). OOP spending was as high as 40% of monthly income. Health insurance ownership was at 42%, but only 16% of the insured reported their health insurance was portable, resulting in high OOP payments when they travelled across borders. 93% of LDT reported using financial services on mobile phones including money transfer, saving, borrowing, mobile banking, and purchasing goods and services. 58% of respondents were willing to buy health insurance that was portable whereas 70% were willing to save for health expenses with 40% of them preferring to save on their mobile phones.

Conclusion: Mobile populations spend a significant amount of time away from home. Majority reported high OOP payments for healthcare services, exposing them to catastrophic health spending. LTD's high use of mobile platforms provides an opportunity to design mobile-based products that improve financial protection for health expenses. For example, healthcare savings accounts can leverage existing partnerships for cross-border money transfers on mobile networks in the region. Extending healthcare savings across borders could also include a function where healthcare providers can receive payment for services rendered at the time healthcare is needed through the mobile money platform. In addition, these platforms could be used by insurers to reduce acquisition costs for registering new clients, renewals and premium payment. Other opportunities to reduce insurers' administration costs include communication, distribution of health promotion messages, and claim payments.

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The Digital REACH Initiative and Role of Interoperable Health Information

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This paper outlines a new initiative of the East Africa Community known as the Digital Regional East African Community Health Initiative (Digital REACH Initiative). Specifically, the paper describes how the combination of three critical open source programmes can provide the reliable, interoperable infrastructure required by the Digital REACH initiative to achieve its goals of improved economic efficiencies, health system effectiveness and faster and better implementation of health interventions. The three programmes are: 1) the Columbia International eHealth Laboratory (CIEL) and its multi-lingual, multi-national concept dictionary; 2) the OpenMRS electronic health record platform and community; and 3) the Open Concept Lab platform for dictionary management and governance. Together, these technologies ensure that heath information collected at the level of individual patients, plus the aggregated data as described in indicators and metrics, can not only be captured across the East Africa region, but can be shared among key stakeholders to facilitate the goals and outcomes as exemplified by the Digital REACH Initiative.

Keywords: Heath information technology, Terminology as a topic, Vocabulary, controlled, Information, dissemination, Africa, Eastern

1 Introduction

The East African Community (EAC) has undertaken an ambitious effort to use digital technology to transform the East African health sector by strengthening the health systems and achieving the Sustainable Development Goals (SDGs). The East African Health Research Commission (EAHRC), in its 2016-2021 strategic plan, mandated the use of health technology. The Digital Regional East African Community Health Initiative (Digital REACH Initiative) aims to achieve that mandate. The following description comes from the Executive Secretary of EAHRC, Professor Gibson Kibiki: Bringing together governments of the EAC countries, development partners, and the private sector, the Digital REACH Initiative will build on and work with – rather than replace – national health programmes and strategies. It is an implementation-led initiative that strives to improve health outcomes across the region through the creation of a robust enabling environment and strategic regional digital health programmes. [1]

The Digital REACH Initiative proposes to use a coordinated, collaborative, regional effort to allow the EAC to:

- **Achieve Economic Efficiencies** through cost savings, economies of scale, and sharing of digital health resources across the region.
- **Support Improved Health Systems** by enhancing data sharing, policies and standards, access and continuity of care, surveillance, and use of data for decision making.

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- **Yield Faster and Better Implementation** by positioning the region as a digital health leader, accelerating implementation progress within and across Partner States, supporting the use of evidence for decision making, and sharing best practices [1]

The EAHRC has not only put together the high-level roadmap for this digital health initiative, it has also produced a detailed strategic plan which will be necessary to achieve the ambitious goals of the effort. We believe that creating a unified framework for achieving regional health goals will require advances in *people, processes and tools* where the global health informatics community can be helpful. Specifically, the interoperability of health information across the regional barriers created by differences in language, health care delivery systems and governance could be advanced using the experience of the Columbia International eHealth Laboratory (CIEL) [2], the Open Concept Lab (OCL) [3] and the OpenMRS [4] community in East Africa.

This paper will outline the authors' ideas about how a curated, but community-managed and shared terminology resource could be leveraged across a large community of health care implementations to lay the groundwork for regional digital health integration.

2 Materials and methods

The activities of the Digital REACH Initiative were initially broken down into different health-program categories, including:

- **Public Health Education and Awareness** - Improve direct provider-to-patient care, community knowledge and services, as well as patient education for preventive care and behavior change
- **Diagnostic and Treatment Support** - Share health records to improve access, continuity and efficiency of care and support portability of health insurance at the regional level
- **Health Worker Education and Training** - Support capacity building through training, knowledge sharing, and performance management
- **Surveillance and Response** - Build capacity and improve surveillance to prevent, detect, and respond to infectious diseases, emergencies, and outbreaks
- **Supply Chain Management** - Improve supply chain efficiency and drug procurement, and economies of scale through better tracking and bulk purchasing
- **Resource Allocation and Management** - Develop a long-term sustainable financing strategy, facilitate resource planning, management, and tracking that optimizes resource mobilization and deployment
- **Population Health Status** - Optimize data sharing, track regional priority patient indicators, and promote use of health research to support health policies and health agenda [1]

These activities share a requirement for clear, reliable and codified data about the patients, providers and health systems across the East Africa region. Whereas all of the health program areas listed above are unlikely to be addressed at one time, a recognized maturity model would allow for programs to be built out and implemented sequentially without significant retooling. Establishing trust and a proven track record in successful implementation would build momentum and make it easier to achieve to roll out more patient-specific program goals. Reliable, interoperable health information is an essential pre-requisite and multiple levels, but has been a challenge to development for decades. [5] However, greater attention is being paid to this foundational requirement today.

The Columbia International eHealth Laboratory (CIEL) is an academic organization at Columbia University in New York City that provides health informatics support to the global community. It is most well-known for the CIEL concept dictionary which provides a core set of 50,000 or so concepts mapped to international standards for the OpenMRS electronic health record platform.[2] The CIEL dictionary includes translations into multiple different languages and has supported the transfer of interoperable health information across multiple countries as part of the Millennium Villages Project and others. It supports the capture and coding of a wide-range of concepts which would be required for the Digital REACH Initiative program areas above. Diagnoses and diseases, procedures and treatments, immunizations and history, medications and medical supplies are all part of the CIEL dictionary.

OpenMRS is one of the most-adopted open source electronic medical record system globally with several different distributions in 3,037 sites, with 8.7 million patient records in over 64 countries [6].

OpenMRS is a modular tech platform which is supported by a broad and diverse community globally. Focusing on resource-constrained settings, OpenMRS is sensitive to the needs of patient populations, development organizations and national ministries of health in low and middle income countries.

For the CIEL dictionary to be properly integrated into a health information system such as OpenMRS, and to provide a platform for communication and governance, the Open Concept Lab (OCL) is required. OCL grew out of an initial project which harmonized maternal and child health concepts from different projects called the Maternal Concept Lab. This site allowed users to quickly search and map from their own terms to published dictionaries like CIEL. OCL is a significant enhancement, providing a tool set to peruse published sources of terminology and higher-level semantic entities like indicators and measures. It provides the necessary synching function between the external sources of dictionaries and the dictionaries which exist inside the health record. OCL was initially developed to aggregate and standardize HIV reporting indicators as well as provide a more efficient integration of CIEL into OpenMRS instances. PEPFAR is incorporating OCL into the DATIM ecosystem to host PEPFAR indicators and to automate transformations of country-level results data into standardized indicator representations. It is expected that DATIM will be using OCL to facilitate data transformations in ten countries by the end of 2018, with more countries expected in subsequent years. The OpenHIE Metadata Clearinghouse now provides a way to publish OCL definitions and meta data to be shared among a larger population of stakeholders. In addition, OCL plans to introduce mobile and web-based, non-technical, read-only access to be used as a reference guide.

3 Results

By providing sharable definitions for data and indicators, we can empower stakeholders to exchange data effectively and make interoperability possible [7]. For data use to be institutionalized among the East African Community, there are several key obstacles that must be overcome: 1) there is limited access to already-defined indicators and terminologies, such as reference terminologies (WHO ICD-10, LOINC, HL7) or country-defined content such as Health Management Information System (HMIS) indicators or subsets representing domain-specific priorities; 2) it is hard to find appropriate and accessible tools to support the metadata management and publication needs of resource-constrained governments or organizations.

OCL has already provided essential support services to the Government of Ethiopia in its development of its national health data dictionary (NHDD). CIEL supported the terminology work as curators and editors, and additional concepts were added to the concept dictionary when they were required by the users. OCL and CIEL worked together to facilitate the communication around the data dictionary elements and the software and editorial support, respectively, were necessary for a successful outcome. [7]

The combination of a controlled clinical terminology like CIEL with a platform like OCL provides a critical foundation for regional shared health information technology as envisioned by the Digital REACH Initiative and can overcome the obstacles mentioned above. The integration into an open source health information system like OpenMRS allows for the standard language and coded instance data to be used by regional providers and decision-makers to monitor health and disease and the people and health systems across the region.

4 Discussion

CIEL as incorporated into OpenMRS has already demonstrated the ability to capture real world patient data in a standardized and interoperable manner. OCL has shown that it can share higher-level indicator definitions to facilitate data sharing for PEPFAR and support the governance process around the development of a national health data dictionary in Ethiopia. OpenMRS and OCL are already working together to facilitate the dissemination and integration of the CIEL into the wider OpenMRS community. All together, these technologies provide the capacity to build out local health information systems which can interoperate across regional boundaries. Although it might be necessary to stage implementations to first meet the needs of individual countries, a maturity model would allow each to grow into larger data sharing and reporting networks without the need to retool or change health information systems.

In addition, as the Digital REACH Initiative clarifies its strategic plan, there will likely be an evolution from the core services described here to include more technologically advanced interventions like machine learning and artificial intelligence. For the EAC to benefit from these more advanced interventions, the underlying data must properly represent the often underserved or under-representative population of the region [8]. The ability for foundational technologies like CIEL, OCL and OpenMRS to be configured for each specific country and population, yet collect and share information in a common manner, makes the use of advanced technologies and the ambitious goals of programs like the Digital REACH Initiative possible.

Acknowledgements

The authors would like to thank the large number of contributors to the CIEL, OCL and OpenMRS communities, without whom this work could not be completed.

Statement on conflicts of interest

Dr. Kanter is Chief Medical Officer for Intelligent Medical Objects, Inc., a US-based health technology company which supplies clinical interface terminology services to CIEL and English-speaking countries globally. Neither he, nor Jonathan Payne, are directly affiliated with the Digital REACH initiative and do not speak officially for the initiative.

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Where are we losing our newborns? Differences in Perinatal data at hospital and national level. A Case study of Nyathuna Sub-County Hospital

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Background and Purpose: Errors during the process of data collection, collation and transfer in healthcare can lead to mistrust in routine health information systems, affecting decision making (policy making, research, clinical decision making and operational management) at the different levels of the healthcare system. With the devolution of healthcare delivery in Kenya, at least two health information systems are in operation, the hospital system known as Check Health Information System (CHIS) and at national level the DHIS2, an open source software platform. We set out to determine if there were significant differences in the two systems with respect to perinatal care at Nyathuna sub-county hospital, Kiambu County.
Methods: Data abstraction of records of perinatal patients (maternal register MOH-333) for the period 1st July 2016 to 30th June 2017 was done. The number of deliveries, live births and still births were tallied and compared to the information available on DHIS2.
Results: From CHIS a total 190 deliveries occurred: 188 live births and 2 still births, while DHIS2 reported 182 deliveries: 180 live births and 2 still births, a difference of eight live births. The observed difference was 4% of data missing from the dhis2 database.
Conclusions: In 2017 Kenya reported 1,697,029 live births [4]. If the reported difference of 4% were to hold true then 67,881 births, (equivalent to a perinatal mortality rate of 40 per 1,000 live births) may not be accounted for in our health information systems. This has serious implications for decision making at operational and policy level. Efficient and effective monitoring of data systems is needed to ensure healthcare decisions are based on verified data.

Keywords: Health Information systems, Maternity Register MOH-333, Perinatal data.

1 Introduction

Health Information generated enables policymakers and service providers to make informed clinical decisions, conduct research and enable operational management as well as supporting transparency and accountability. In recent years we have seen an increasing focus on health information systems globally, with significant human and financial resources being invested at various levels to improve them [1] being reflected by the neonatal mortality rate of 20.9 deaths per 1,000 live births in 2017[2] whilst maternal mortality ratio of Kenya at 510 deaths per 100,000 live births in 2015[3]. However, erroneous processes of data collection, collation and transfer lead to mistrust in routine health information systems and affect overall usage of said data in policy and decision making.

In this descriptive study, existing data between two different health information systems was compared and analysed to note significant differences that would eventually affect the use of this data at a national level. The overall objective was to determine if there were significant differences in the two systems with respect

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to perinatal care at Nyathuna sub-county hospital, Kiambu County. The purpose of this study was to analyse data collected and recorded on total number of deliveries recorded on the hospital system known as Check Health Information System (CHIS) and at national level the DHIS2, an open source software platform,

2 Materials and methods

2.1 Data Collection

The data used to analyse perinatal deliveries was collected from two systems: The Maternity Register, MOH-333 at Nyathuna Level 4 health Centre and the DHIS 2 open software system. The primary data was obtained from the register in form of the date of delivery and the outcome of the delivery whether live or stillbirths. The evidence of an event of delivery taking place was the recorded date of delivery. Due to the sample size, we employed a census sampling technique whereby information was gathered on every record that was available in the register for the financial year beginning July 1st 2016 till June 30th 2017.

2.2 Data Analysis

Data analysis was both qualitative by observation of the data entered into the Maternity Register MOH-333 and the state of data in the register and quantitatively through tallying of the number of maternal deliveries per month whilst comparing in to the data reported in DHIS 2 in the specified period.

3 Results

The results are presented in the table below and further discussion in the sections that follow. Since data reported on DHIS2 [5] is collected from the maternity register MOH-333[6], it is expected that both data will be similar and there will be no discrepancies observed.

From the tabulated findings, there was a difference of 8 live births and 8 total deliveries between the Nyathuna Maternity Register and the dhis2 database. The reported tally of stillbirths was identical with both Nyathuna and dhis2 reporting 2 still births within the period of study. There was no record of referrals on the dhis2 database.

Financial year	Admissions	Live births		Still births		Referrals	Total deliveries	
		Dhis2	*Nyat*	*Dhis2*	*Nyat*		*Dhis2*	*Nyat*
July 2016	25	19*	20*	0	0	0	19*	20*
August 2016	19	17	17	0	0	0	17	17
September 2016	24	14	14	0	0	7	14	14
October 2016	33	29	29	0	0	3	29	29
November 2016	26	21	21	1	1	2	23*	22*
December 2016	11	11	11	0	0	0	11	11
Januray 2017	6	0*	5*	0	0	1	0	5
February 2017	10	10	10	0	0	0	10	10
March 2017	11	11	11	0		1	11	11
April 2017	25	21	21	1	1	0	21*	22*
May 2017	34	26	26	0	0	7	26	26
June 2017	5	1*	3*	0	0	0	1	3
Total	206	180	188	2	2	21	182	190

3.1 Number of Live Births

The table above compares the total entries on the number of live births at Nyathuna (188) compared to the ones found on the DHIS2 database (180). A record 4.26% of missing data on livebirths from the DHIS 2 database was observed

3.2 Total Number of Deliveries

Dhis2 recorded 182 while Nyathuna reported a total of 190 total deliveries within the financial year. 4.21% of data on total number of deliveries was observed missing from the dhis 2 database.

4 Discussion

With the devolution of healthcare delivery in Kenya, at least two health information systems are in operation, the hospital system known as Check Health Information System (CHIS) and at national level the DHIS2, an open source software platform. However, the implementation of CHIS for Maternal health care has not yet been rolled out in Nyathuna Health Facility, use of the Maternity Register was employed. The results show that 4.26% of missing data on livebirths and 4.21% of data on total number of deliveries was observed missing from the dhis 2 database. These differences could be attributed to human sources of error in tallying, recording and transference of data from the Maternity Register onto the Dhis2 database. In 2017 Kenya reported 1,697,029 live births. If the reported difference of 4% were to hold true then 67,881 births, (equivalent to a perinatal mortality rate of 40 per 1,000 live births) may not be accounted for in our health information systems. This has serious implications for decision making at operational and policy level. Considering that Nyathuna is a Level IV health facility, there should be adequate implementation of the CHIS system to maternal health care to reduce erroneous data handling and enable better planning using adequate, up-to date information.

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The Data Services Layer: A Data analytics approach to evidence-based decision making for healthcare in Kenya

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Abstract. This concept paper explores the development of the Data Services Layer (DSL) which forms part of the Kenya Health Enterprise Architecture (KHEA) with the objective to comply with the requirements of information presentation services, data transport services and application services. The history of HIS development in Kenya is disparate health systems. DSL aims at using the vast data available in different systems to inform decisions. Big data concepts, open source tools, platforms to unify multiple, and parallel data source systems integration processes are utilized. The infrastructure consists of open source tools; Linux boxes, PostgreSQL, Pentaho, Apache Spark, Power BI and R for visualization. The DSL consists of a data warehouse and a web portal for data visualization. The data warehouse is composed of 3 clusters with RAID 1+0 storage configuration for fault tolerance and high-speed data access. The DSL is able to triangulate 26 indicators drawn from the Kenya Health Sector Strategic Plan (KHSSP 3). The DSL has modules that are being refined to support data analytics and data mining. These would include simple analytical tools such as MS Excel and pre-populated reports for entry level users and advanced analytical tools such as Power BI, R or Tableau.

Keywords: Big data, Interoperability, Analytics, Data Warehousing, Extraction transformation and Loading, Data Collection Methods, Evidence Based Decision Making, Kenya Health Enterprise Architecture.

1 Background

Access to health care may vary across countries, communities, and individuals, largely influenced by social and economic conditions as well as the health policies in place. Countries and jurisdictions have different policies and plans in relation to the personal and population-based health care goals within their societies. Healthcare systems are organizations established to meet the health needs of targeted populations. Their exact configuration varies between national and subnational entities. In some countries and jurisdictions, health care planning is distributed among implementing partners, whereas in others, planning occurs more centrally among governments or other coordinating bodies. In all cases, according to the World Health Organization, a well-functioning healthcare system requires a robust financing mechanism; a well-trained and adequately paid workforce; reliable information on which to base decisions and policies; and well maintained health facilities and logistics to deliver quality medicines and technologies (WHO, 2009) Health care is conventionally regarded as an important determinant in promoting the general physical and mental health and well-being of people around the world. The quantity and quality of many health care interventions are improved through the results of science, such as advanced through the medical model of

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health which focuses on the eradication of illness through diagnosis and effective treatment. Many important advances have been made through health research, biomedical research and pharmaceutical research, which form the basis for evidence- based medicine and evidence-based practice in health care delivery. Health information technology is "the application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and use of health care information, data, and knowledge for communication and decision making." (Alkhatib, 2015). Technology is a broad concept that deals with a species' usage and knowledge of tools and crafts, and how it affects a species' ability to control and adapt to its environment.

1.1 Purpose

The citizens of Kenya are guaranteed the right to the highest attainable health standard under article 43 of the constitution of Kenya 2010 (Constitution, 2010). The Kenya Health Sector Strategy aims to transform Kenya, by aiming to attain the right to health and universal health care and to devolve health services management (the Republic of Kenya, 2013). Towards this end, the Ministry of Health (MoH) has developed the Kenya Health Policy (KHP 2014 - 2030), which has defined a long-term policy for the Country guided by the need to achieve the goals set out in the vision 2030 (WHO, 2009). The goal of Kenya Health Sector Strategy is to review the imbalances in health care services and improve the trends in health-related outcome indicators (Ministry of Health & Health Sector Reform Secretariat, 2005). The 5 Strategic Objectives of the Second National Health Sector Strategic Plan (Ministry of Health, Kenya, 2005) are the guiding principles in the strengthening of interventions envisioned in this strategic plan. The Data Services Layer (DSL) architecture forms part of the Kenya Health Enterprise Architecture (KHEA) whose objective is to comply with the requirements of Information Presentation Services, Data Transport Services and Application Services.

The DSL aims at using the vast data available in different systems to inform decisions. Big data concepts, open source tools, platforms to unify multiple, and parallel data source systems integration processes are utilized.

2 Methods

Data analysis is a process of inspecting, cleansing, transforming, and modelling data with the goal of discovering useful information, informing conclusions, and supporting decision-making. Data analysis has multiple facets and approaches, encompassing diverse techniques under a variety of names, while being used in different business, science, and social science domains.

2.1 The process of data analysis

Statistician John Tukey defined data analysis in 1961 as: "Procedures for analyzing data, techniques for interpreting the results of such procedures, ways of planning the gathering of data to make its analysis easier, more precise or more accurate, and all the machinery and results of statistics which apply to analyzing data."

There are several phases that can be distinguished, described below. The phases are iterative, in that feedback from later phases may result in additional work in earlier phases.

2.2 Data requirements

As the volume of healthcare data rapidly increases healthcare organizations are searching for better data management solutions (Raghupathi & Raghupathi, 2014). Kenya has in the recent past generated large volumes of data in the health sector. This data has largely been in various disparate systems that collect data for various purposes (Mureithi, 2014). This paper focuses on for distinct sources which collect data regarding; Health human resource, Health Infrastructure, Health commodities and Service Delivery. These four distinct systems are that hold this data iHRIS, KMHFL, LMIS and DHIS2 Respectively. This data sets are specified based upon the requirements of the MoH. The general type of entity upon which the data will

be collected is referred to as an experimental unit. Specific variables regarding a population may be specified and obtained (Khan, 2014). Data may be numerical or categorical.

2.3 Design

We focus on the use of the open source tools and platforms to unify multiple, parallel data source systems into a single integrated, web-based National Health Information System that improves the collection and analysis of health and health related data that are used for programmatic and policy decision making (Russom, 2011). The paper evaluates the use of Big Data concepts in the development of the DSL, data warehousing methods, data transformation methods as well as data analytics methods.

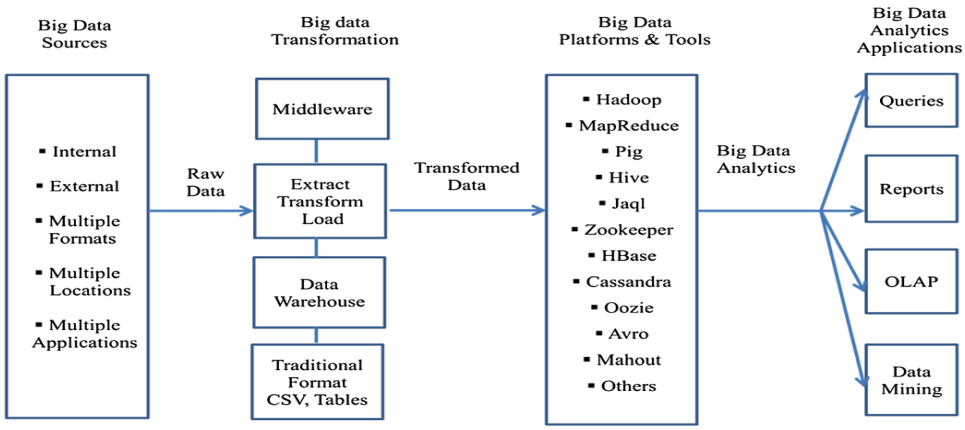

Figure 2. conceptual architecture of big data analytics

The infrastructure consists of open source tools; Linux boxes, PostgreSQL, Pentaho, Apache Note, Apache Spark, PowerBI and R for visualization. The DSL consists of a data warehouse and a web portal for data visualization. We will be sourcing raw data from four distinct systems to be used in the development of the data warehouse. The data will be transformed and loaded into the developed warehouse.

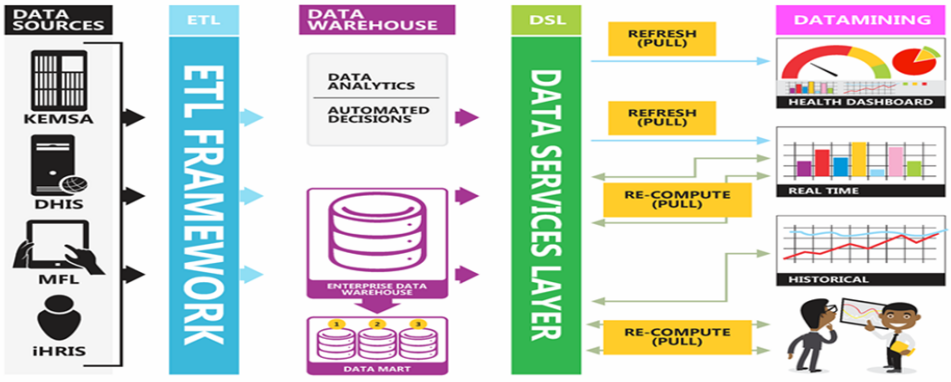

Figure 3. architecture of the proposed method

The Data warehouse is composed of 3 clusters with RAID 1+0 storage configuration for fault tolerance and high speed reads and writes for fast data access. The data warehouse is anchored on PostgreSQL. We use PostgreSQL as an object-relational database management system because it is capable of handling small databases to large complex data warehousing projects.

The big data file management platform in use is Apache Spark. The visualization platform consists of 3 Linux servers clustered through Apache Spark to enable rapid data querying.

Pentaho Data Integration:

is an open source tool used for Extraction, Transformation, and Loading (ETL) processes. The ETL tools will be used to load data into a data warehouses environment, as well as;

- Moving data between different databases and applications
- Exporting data storage.
- Data cleaning

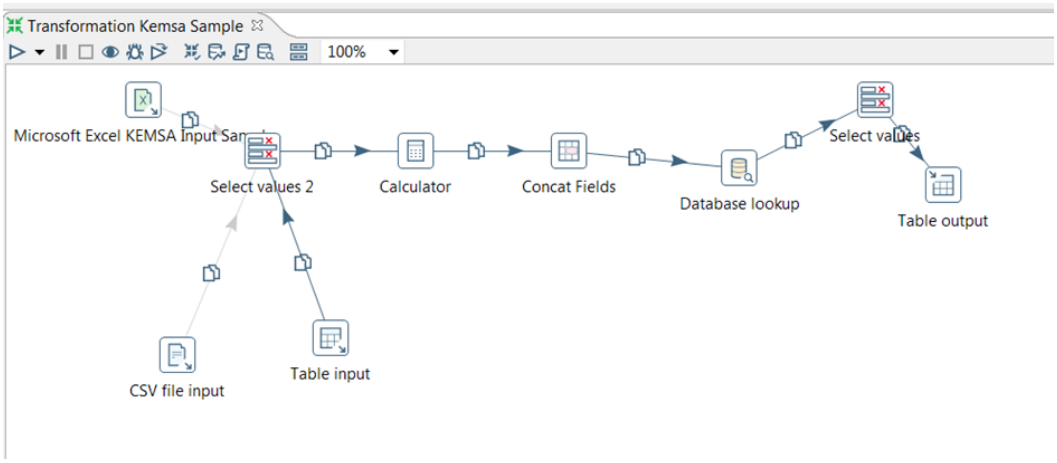

Figure 4. Data transformation process

The data will then be visualized using a data visualization tool. The available tools for the visualization of this data Include;

PowerBI. is a business intelligence tool that is used to analyze and visualize data. This tool allows end users to visualize data and create dashboards by themselves. This tool is a product of Microsoft and is available for free. It provides both simple and complex business intelligence models and users can be able to visualize data with minimal training.

Tableau. is a business intelligence tool that is used to analyse and visualize data. This tool allows end users to visualize data and create dashboards by themselves.

2.4 Exploratory data analysis

Once the data is cleaned, it can be analyzed. Analysts may apply a variety of techniques referred to as exploratory data analysis to begin understanding the messages contained in the data. The process of exploration may result in additional data cleaning or additional requests for data, so these activities may be iterative in nature. Descriptive statistics, such as the average or median, may be generated to help understand the data. Data visualization may also be used to examine the data in graphical format, to obtain additional insight regarding the messages within the data.

3 Results

The DSL is able to integrate data from several disparate systems; LMIS, DHIS2, KMHFL and IHRIS. The DSL is able to triangulate 26 key performance indicators drawn from the strategic policy objectives found in the Kenya health sector strategic plan (KHSSP). The DSL has in place, modules that are being refined to support data analytics and data mining. The modules will be customized Data Access on DSL targeted to user capabilities and capacities in data analytics. These would include simple analytical tools such as MS Excel and pre-populated reports for entry level users to complex analytics using advanced analytical tools such as MS Power BI, R or Tableau.

The integration however is not devoid of challenges. The integration of the various disparate systems poses a challenge since the systems are not all based on open standards. Open standards rely on a broadly consultative and inclusive group including representatives from vendors, academics and others holding a stake in the development that discusses and debates the technical and economic merits, demerits and feasibility of a proposed common protocol.

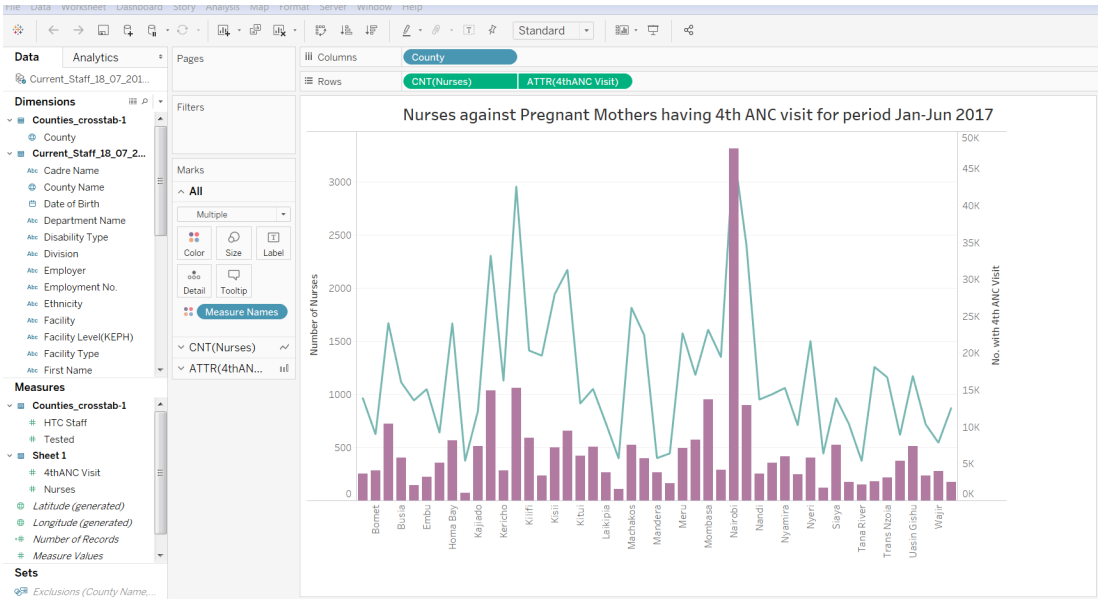

Figure 5. Figure showing data triangulated form DHIS2 (indicators) and iHRIS (Staff)

4 Conclusions

Although the DSL has been partially successful as a proof of concept, we were faced with numerous challenges of interoperability. Interoperability is a characteristic of a product or system, whose interfaces are completely understood, to work with other products or systems, at present or in the future, in either implementation or access, without any restrictions. If two or more systems are capable of communicating with each other, they exhibit syntactic interoperability when using specified data formats and communication protocols. XML or SQL standards are among the tools of syntactic interoperability. This is also true for lower-level data formats, such as ensuring alphabetical characters are stored in a same variation of ASCII or a Unicode format in all the communicating systems.

Beyond the ability of two or more computer systems to exchange information, semantic interoperability is the ability to automatically interpret the information exchanged meaningfully and accurately in order to produce useful results as defined by the end users of each of the tested systems (Watson, 2014). To achieve semantic interoperability, the LMIS, DHIS2, iHRIS and KMHFL must refer to a common information exchange reference model. The content of the information exchange requests are unambiguously defined: what is sent is the same as what is understood. The possibility of promoting this result by user-driven convergence of disparate interpretations of the same information has been object of study by research prototypes such as S3DB.

Interoperability is used to describe the capability of different programs to exchange data via a common set of exchange formats, to read and write the same file formats, and to use the same protocols. The lack of interoperability can be a consequence of a lack of attention to standardization during the design of a program. Indeed, interoperability is not taken for granted in the non-standards-based portion of the computing world.

This paper recommends that more research be done to evaluate the ability of health systems to provide services to and accept services from other systems, and to use the services exchanged to enable them to operate effectively together. This paper has not had the opportunity to carry out deep and lengthy integration

to establish with certainty the depth to which health and health related systems can interoperate as it is still work in progress.

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Leadership Development and Governance Groups Model: A catalyst to strengthening Measurement Learning and Accountability Systems

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[1]USAID-Tupime Kaunti Project

Background and Purpose: World Health Organization recognises the critical role of leadership and governance in the health systems as one of the health systems blocks. While many interventions have focused on the role of leadership in the health systems, there has been minimum attention to the influence of leadership in Measurement Learning and Accountability (MLA). In particular, integration of the numerous leadership teams outside the departments of health whose functions require reliance on M&E outputs for decision-making on planning, resource allocation and policy has not been fully realized. The Leadership Development and Governance (LDG) groups approach provides a platform for leadership teams outside the department of health including Treasury and Planning to enhance joint utilization of data for decision-making.
Methods: A MLA assessment conducted in March 2017 in eight counties namely: Busia, Bungoma, Homa Bay, Kakamega, Kisumu, Kisii, Migori and Vihiga documented gaps in leadership and governance impeding MLA systems. A capacity building plan to address the gaps was developed and is being implemented. A maturity model that outlines progressive growth path for the LDG groups towards a strengthened MLA system is in place
Results: The LDG groups are steering policy development, reviews, monitoring and evaluations. Through the LDG groups, the county treasury and planning department are utilizing data from department of health to make decisions in planning and resource allocation.
Conclusion: The LDG group approach offers an innovative and sustainable capacity-strengthening model for upscaling data use at leadership level.

Keywords: Leadership Development and Governance Group Measurement Learning and Accountability.

1 Introduction

The leadership and governance of health systems, also called stewardship, is arguably the most complex but critical building block of any health system (World Health Organization, 2007). It is concern with setting policy direction, structures for service delivery, managerial processes, and accountability and partnership mechanisms. The United Nations Development Program five principles of good governance (legitimacy, vision and strategic direction, performance, accountability, equity and fairness of processes) are useful in framing what is required for a functional health leadership and governance system. The WHO TAPIC Framework (2016), also outlines five dimensions that are key in health systems governance: transparency, accountability, participation, integrity and policy capacity.

A pivotal function of leadership and governance is Measurement, Learning and Accountability (MLA) which is a foundation of results-oriented institutions. A functional MLA system consists of: strong leadership and governance frameworks, adequate resources (human and financial), vibrant internal and external coordination mechanisms, accompanying health information systems (HIS) that enable health

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leaders to demand and use information for decisions, demonstrate results and learn from implementation. The success of MLA is highly dependent on health leadership and governance capacity.

In the context of the Kenya county health system, there are a number of governance structures that determine prioritization and decisions regarding health, yet some are not within county departments of health like Treasury and Planning. The complexity of processes within and without the county departments of health requires significant coordination to realize the desired goal of a strengthened MLA system. Further, the partnership and stakeholder coordination frameworks have always placed emphasis on external stakeholders and have not adequately addressed the leadership teams in the other departments.

'Strengthening leadership in health requires a focus on ensuring an eco-system that enables participation from diverse actors, nurtures debate and provides an opportunity for all actors to assert their leadership potential, as the need arises, to the benefit of improved health-system performance' (WHO, 2016).

A Leadership Development and Governance (LDG) group anchored within the Department governance structures is one such innovative strategy being implemented by the USAID-Tupime Kaunti project that aims to address the aforementioned challenges. The LDG is a core group comprising of leadership members drawn from the department of health, Treasury and Planning that steers MLA at county level. The strategic value in the LDG approach is in: targeted coordination of internal actors in the County Government, evidence-based policy making, catalysing MLA leadership and governance capacity building, championing the use of data and strengthening advocacy for the health agenda. The LDG group approach aligns with other recognized frameworks that have been developed and tested. Strengthening leadership in complex health systems is a system-wide reform, requiring collaboration between current health system leaders, educators and other groups (Cassels and Janovksy, 1991).

2 Methods

The objective of the intervention was; to strengthen leadership and management capacities for MLA institutionalization. The USAID-Tupime Kaunti project conducted a comprehensive Measurement Learning and Accountability assessment in March 2017 in eight counties namely; Busia, Bungoma, Kakamega, Kisii, Kisumu, Homa Bay, Migori and Vihiga counties. The MLA assessment was conducted using mixed methods including qualitative and quantitative methods. The focus was on MLA six components namely; leadership and governance, financing, workforce, information management and evaluation, data use and coordination and networks.

Consultative meetings were held to validate the findings and to establish the LDG groups for the various counties. Capacity building plans were developed for each of the LDG group outlining capacity gaps that need to be filled for the LDG groups to implement the MLA interventions. The Project invested in addressing immediate skill gap of policy formulation which the LDG groups required to guide strategic plan development. To measure the progression of the LDG groups towards maturity the project developed a maturity model outlining the various growth stages towards the desired strengthened MLA systems. Further a functionality matrix was developed that has been applied in measuring the functionality levels for the LDG groups in terms of executing the MLA systems strengthening interventions.

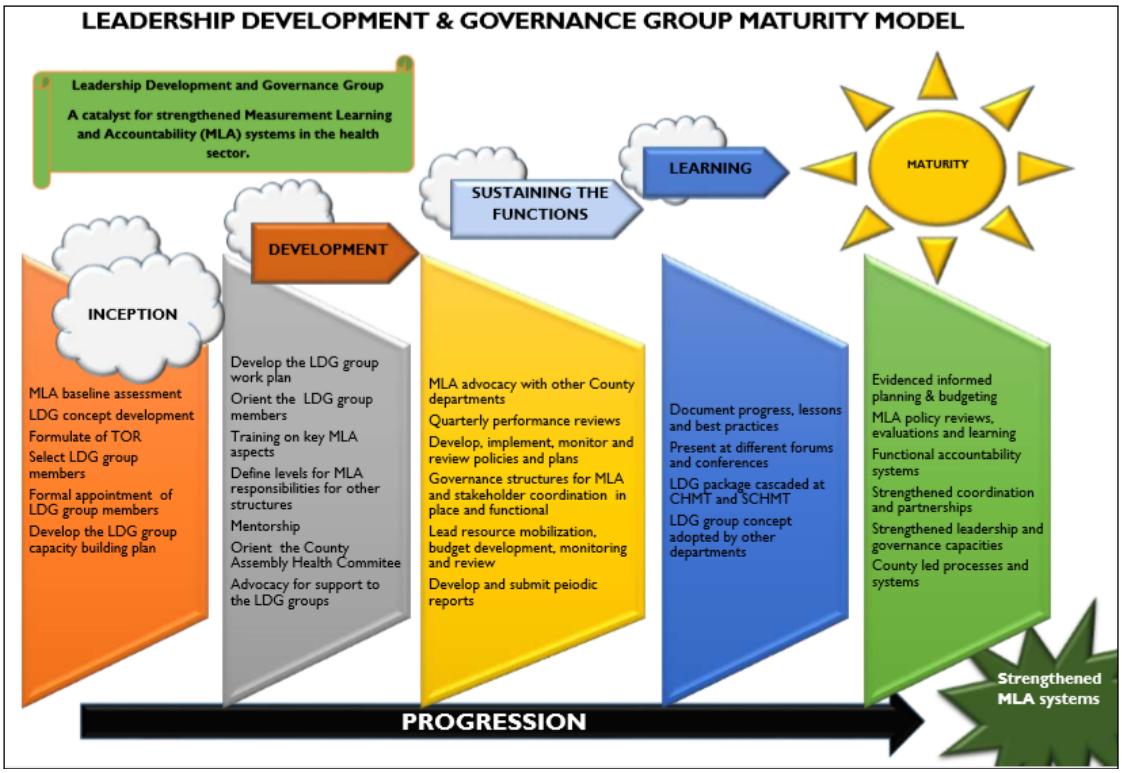

Figure 1. LDG Group Maturity Model (USAID-Tupime Kaunti Project, 2018)

3 Results

The LDG groups are steering policy development reviews, monitoring and evaluations. The LDG groups have utilized the skills and completed an end term review of the County Health Sector Strategic and Investment Plans 2013 – 2018 and used the evidence to inform the strategic planning for 2018 – 2023. Previously the development of strategic documents was steered by externally by consultants. Through the LDG, the county treasury and planning department are utilizing data from department to make decisions in planning and resource allocation. Dr Arthur Andere the Acting County Director of Health, Kakamega County and a member of the LDG, highlighted his previous experience in development of the strategic plans in June 2018 and noted;

> *"Five years ago, we developed our County Health Sector Strategic and Investment Plan with support of a consultant from one of our partners. This time, LDG members trained by Tupime Kaunti have steered and coordinated development process of county strategic plan in its entirety. In this way, this new strategic plan is better than the earlier one".*

There is improvement in continued engagement with the County Assembly Health Committee in joint review of performance and planning. The LDG groups have been able to sensitize this committee on the health priorities and through these efforts budget allocations have increased.

The LDG groups have been instrumental in streamlining stakeholder coordination mechanisms by developing a framework for stakeholder coordination. Previously this documented coordination mechanisms were lacking to guide structured engagement of stakeholders and their participation.

Utilizing the functionality matrix, progress of the LDG groups towards reaching maturity was assessed from July – October 2018 in four counties namely; Kisii, Migori, Kakamega and Homa Bay. The findings revealed that the progression was varied. The active participation of the core health leadership of Migori County in LDG group meetings was highlighted as a driving success factor for the LDG group. For Homa Bay County, the progress in development of policy including the draft health bill and the County Health Sector Strategic and Investment Plan (CHSSIP) 2018 – 2023 was documented as a key milestone, though participation of the core health leadership was noted as an area of improvement. In Kisii the transition of the LDG group to an internal structure for sustainability demonstrates the value attached the LDG concept.

County	LDG functionality score
Kisii	69%
Migori	74%
Homa Bay	54%
Kakamega	46%

4 Discussions

The LDG group model demonstrates how other decision makers outside the department of health that have significant influence can be coordinated for joint decision making. In counties where this coordination worked very well, the leadership teams reported progress in reporting, resource prioritization and allocation of resources. This is in line with the TAPIC framework and the LDG maturity model. All the four counties, reported to have convened LDG group meetings that were data driven and focussed on; review of performance across key indicators,

Further, the LDG groups led the process of development of the County Health Sector Strategic Plans. Previously these plans were externally driven with the county health leadership teams participating as contributors. Importantly is to ensure that leadership teams spread within and without the department of health with significant influence are well coordinated.

The LDG group has provided the opportunity for the County Executive Committee Member (CECM) of Health who represent the political arm to have an in-depth understanding of the health situation and priorities. As a result, they have been able to package this information for targeted advocacy. The LDG group has also provided a platform and linkage with the legislative arm of government; the County Assembly Health Committee that is responsible for policy making, oversight and budget allocation. Specifically, the working relationship between these two arms of government has improved, there is unified understanding of the health priorities and requirements and a reporting framework established. Gilson L, Agyepong I. (2018), suggest that it is not enough to train individuals; instead it is necessary to engage workplace teams in leadership development programmes—especially given the inter-disciplinary requirements of health care and the need for inter-sectoral actions to promote health. It is also not enough to train leaders away from their workplaces; instead experiential skills and tacit knowledge must be developed within workplace teams.

Source of support: USAID KEA

Disclaimer: The implementation of the LDG group concept was made possible by the USAID Tupime Kaunti Project. The information herein does not necessarily reflect the views of USAID or the U.S. Government and are the sole responsibility of Tupime Kaunti project.

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The authors acknowledge the contributions of LDG groups in the eight counties namely; Busia, Bungoma, Kakamega, Kisii, Kisumu, Homa Bay, Migori and Vihiga counties.

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Institutionalizing Measurement Learning and Accountability systems

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Plan International (USAID Tupime Kaunti Project)

USAID-Tupime Kaunti project focused on Measurement Learning and Accountability (MLA) capacities assessment and technical assistance for the eight target counties. Institutionalization refers to the assimilation of concepts into policies and plans. Most interventions leading to development of action points lack measures on how the actions to address identified gaps will be assimilated into county plans for resource allocation hence their implementation.

The eight counties were supported to conduct self-assessment of their Measurement Learning and Accountability (MLA) capacities. The approach of self-assessment by the county involved leaders and implementers who steered the entire process and thus created ownership. The developed MLA action plan was anchored within the department of health leadership for action. The Leadership Development and Governance group. Ownership and anchoring the action plan within the department decision makers is key toward institutionalization. When points are utilized to inform development of county plans, resources are allocated to them for substantial implementation. Monitoring of their implementation and continuous advocacy is key for systems and structures support through various intervention that end product is an action plan.

1 Introduction

Provide a context or background for the study (that is, the nature of the problem and its significance). State the specific purpose or research objective of, or hypothesis tested by, the study or observation. Cite only directly pertinent references, and do not include data or conclusions from the work being reported.

In Kenya, devolved structures of government call for a heightened need for Measurements Learning and Accountability (MLA) systems to increase measurement and accountability for resources and results at county levels. A recent release by WHO/World bank recognizes a growing need for timely and accurate quality data and synthesized information for planning, implementation, policy development and decision making.

Strategic Information (SI) is an ingredient in strengthening transparency, accountability and use of quality data for informed decision making in health. Measurement Learning and Accountability is key in strengthening Health Information System and structures. Systematic baseline assessment of MLA capacities in key to provide gaps for planning, implementation and decision making. However, this is hampered by various limitations that include; insufficient investments within countries, inefficient investments in Measurement Learning and Accountability.

In strengthening Health Information to inform planning, budgeting processes and any other decisions, Measurement Learning and Accountability system in the health sector is critical component to be institutionalized within health systems for resource allocation and implementation. Institutionalization of MLA action points in the counties plan require a baseline assessment to establish county MLA status that will be included into county plans. This is accomplished with technical capacity to monitor implementation status in the county.

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2 Methods

USAID Tupime Kaunti project is mandated to strengthen Measurement Learning and Accountability in eight counties facilitated the counties to conduct baseline self-assessment and development of system strengthening action plan. The main objective was to self-assess counties MLA systems gaps that would inform action plan to be implemented to address identified gaps

A multi-disciplinary team representing the county, sub county and facility level conducted the assessment. The County Director of Health selected and invited participants for the 5-day workshop-based assessment. Each county was facilitated separately from the rest with Reproductive Health (RH), HIV and Malaria, Human resource, treasury and planning being part of the team with the rest being health care workers from the county, sub-county, facility and community strategy coordinator.

The project in collaboration with the county leadership utilized a mix method approach to conduct baseline assessment utilizing pre-designed questionnaire and audial recording devices to capture participant's responses during individual, group and in-depth interviews respectively

To implement the system strengthening action plan, the project supported the county teams to introduce the MLA action points in to county plans for resource allocation, implementation and monitoring of action plans. Each county was facilitated to monitor implementation of the MLA system strengthening plan semi-annually by the LDG group with some action being reviewed more actions being included or revised based on emerging department needs and priorities.

3 Results

All the eight target counties participated in the baseline assessment with each developing an action plan for all the section scoring partial or not at all. The larger County Health Management Teams (CHMT) adopted the county system-strengthening plan. The Leadership Development and Governance (LDG) groups committed to implement the action plan to the latter.

All eight counties utilized the action point to inform development and or prioritization of County Development and Investment Plan (CIDP), Annual Development Plan (ADP), the 2017/18 and 2018/19 Annual Work Plan, the LDG group managed to incorporate most of the action plans from the baseline in the mentioned county plans. Further, the county department of Health heavily borrowed MLA priorities from the MLA system-strengthening plan during the development of 2018/23 County Health sector Strategic (CHSSIP).

Due to the institutionalization, the counties are experiencing better coordination of MLA activities as they are now being implemented; support from partners to implement MLA activities in the county Annual work Plan; There has been establishment of M&E unit and deployment of some staff to the unit as well as resource allocation to the established M&E unit. In addition, there has been adequate advocacy for MLA resource allocation courtesy of LDG group initiatives. Finally, there has been substantial understanding of MLA needs by the county teams.

4 Discussion

All eight counties conducted baseline assessment and developed system strengthening action plan. The average implementation rate of MLA action plan is 80% for all counties with the project advocating for 100% adoption and implementation. The self-assessment approach created ownership of the MLA action points developed. The county leadership selected their teams thus the process being county led with technical support from the Tupime Kaunti project. Participating teams developed and disseminated MLA system strengthening action plans with as well as anchored it to the Leadership Development and Governance group for implementation.

Institutionalization of county action plans requires the county to own the action plan development process and the actions are anchored within the Leadership Development and Governance group. The support by the leadership ensured implementation due to inclusion in the county plans

Lobbying and advocacy of by the leadership and champions are key toward attaining institutionalization. Institutionalization of baseline actions into county plans and strategies is possible. Once institutionalization

is achieved, the next step is support implementation, periodic monitoring of implementation status and feedback.

Acknowledgement

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Finally, yet importantly, I thank the county leadership, Tupime Kaunti Project staff for their technical support institutionalization of MLA system strengthening plan.

Disclaimer: The contents of this manuscript reflects author's opinion and does not necessarily reflect the views of USAID or the United States Government.

Abbreviations

MLA – Measurement Learning and Accountability
SI – Strategic Information
RH – Reproductive Health
HIV – Human Immunodeficiency Virus
CHMT – County Health Management Teams
LDG – Leadership Development and Governance
CIDP – County Integrated Development Plan
AWP – Annual Work Plan
ADP – Annual Development Plan

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Evidence based planning and budgeting for sustained epidemic control

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[2] USAID Tupime Kaunti project

Sustained control of the HIV epidemic requires multi-year, evidence-based national strategies that are prioritized by population, geographic area and interventions; costed; and financed—and reflect the participation and buy-in of stakeholders[1]. Kenya's 2010 constitution presented a new approach where health service delivery was devolved to the county governments. Kenya's Public Finance Management Act 2012 requires all government entities submit work plans to facilitate resource allocation and disbursement of funds. A baseline assessment by Tupime Kaunti project found that in the project focus counties including Migori, planning and budgeting processes in the last five years were not aligned to the planning and budgeting cycle. Consequently, there was minimal consideration to county health priorities and budgets.

The purpose of the intervention was to strengthen capacity of the county managers to develop timely and evidenced based plans and budgets. To address this gap, the project with the financial support from USAID facilitated a training on planning and policy formulation on MTEF cycle to a County Leadership Development and Governance (LDG) group. The LDG thereafter generated annual performance report & plan, sector working group report and annual work plans with program-based budgets.

As a result, the County allocated Kes. 1,5b in FY2018/19 compared to the Kes. 5b in FY2017/18 to HIV program. Involvement of the county planning department and alignment with MTEF cycle is important in ensuring that the budget allocated to the health department is based on its priorities.

1 Introduction

Kenya promulgated a new constitution in Aug 2010 that ushered in a new concept on devolution. According to World Bank, when governments devolve functions, they transfer authority for decision-making, finance and management to quasi-autonomous units of local government with corporate status2. Under the new constitution, Kenya devolved delivery of health services to the county governments. Devolution presented opportunities and challenges for the county governments. Specifically, it presents an opportunity to strengthen inclusion of sub-national governments in decision making on county priorities, equity in resource allocation and greater demand for accountability. On the other hand, there is a capacity gap on appropriate resource allocation and utilization for improved health systems.

Kenya's Public Finance Management Act 2012 requires that all government entities submit a plan to facilitate resource allocation and disbursement of funds. Over the last five years under the devolved systems, the county health departments developed and submitted plans to ensure appropriate allocation of funds. However, submission of the plans and budgets was between Apr and June, a period outside the planning and budgeting cycle. Kenya's planning and budgeting cycle requires that budget estimates are submitted by February of the following year to the county assembly for approval; a process preceded by a

1 Sustainable HIV Epidemic Control - Position paper – November 2016

2 The World Bank Group. (n.d.). Decentralisation and Sub-National Regional Economics

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bidding process to allow for negotiations in budget allocation. The practice in the counties was solely left for the departments planning units and the county treasury, which developed and submitted the budgets without the involvement of the health department managers. Consequently, there was minimal consideration given to actual county health priorities and their equivalent budgets.

Prioritization and determination of resource envelopes begins from 30th Aug and ends in Feb of the following financial year. Kenya's financial year runs from July to June, for example, a FY2017/18 runs from Jul 2017 to June 2018. To strengthen evidenced based planning and budgeting key strategic documents are essential in informing the prioritization and budget allocation. Key strategic document that provides the county priorities and required budget is the Sector Working Group (SWG) Report, also known as the Medium-Term Expenditure Framework (MTEF) report. The year 2018 saw majority of the end of the counties' strategic and investment plans, that provided an opportunity to evaluate achievements made in the last five years post devolution. With the health sector reviews, counties identify priorities for consideration during development of the SWG reports. The potential bottlenecks attached to this step are the delay in the submission of sector working group reports by the County Department of Health (CDOH) and the CDOH may not have the requisite skills in lobbying and preparing reports and gap analyses3.

Tupime Kaunti is a USAID-funded project working in the eight counties of Kisumu, Migori, Kakamega, Busia, Bungoma, Vihiga, Kisii and Homa Bay. The project aims to increase leadership and management capacity of county governments for effective outcome measurements, learning, and accountability systems; and to increase the availability, analysis and use of high-quality data for decision-making. To address the non-alignment to the planning and budgeting cycles, the project laid out interventions with two objectives;

1. To build capacity of the county health management teams in planning and budgeting
2. To support planning and budgeting initiatives for improved health financing

2 Methods

Central to Tupime Kaunti projects' approach is county-led process, which focuses on; assessment of Measurement Learning and Accountability systems and learn; building capacity, strengthening policies and systems as well as using data and act among others. A baseline assessment conducted by the project for the eight counties revealed that developed annual work plans outside the budgeting cycles. Since devolution, it was also noted that the annual work plans were not aligned to the County Health Sector Strategic and Investment Plans (CHSSIPs).

2.1 Selection and Description of Participants

To address this gap, the project with the financial support from USAID facilitated a training on planning and policy formulation on MTEF cycle to a County Leadership Development and Governance (LDG) group. The LDG groups is an innovative approach by the project anchored within the Department of Health leadership and governance structures that brings core health leadership teams and other leadership teams from other county departments together with an agenda of strengthening MLA. The strategic value in the LDG approach is in: targeted coordination of internal actors in the County Government, catalyses MLA leadership and governance capacity building, champions the use of data and strengthens internal advocates for the health agenda.

2.2 Technical Information

A 5-day classroom based policy formulation and implementation training was conducted with facilitation from the Kenya School of Government. One of the component in the training was introduction to Medium Term and Expenditure Framework (MTEF) cycle and budget calendar. Specifically, the participants were taken through; prioritization and determining resource envelopes, Preparation of budget estimates, Legislative approval of budget estimates and Budget execution and monitoring. A highlight on program based budgeting was also provided to ensure that the counties allocated resources to the program with

3 How county health leadership can influence county budgets

highest need. From the training, the participants developed action plans with one of them being to develop the county plans as per the planning and budgeting cycle. The project also supported the review processes of the county strategies and plans to ensure identification of the county priorities.

2.3 Statistics

To ensure that the county teams developed evidenced based plans, the project further supported the end-term-review of the first CHSSIP and a review of the annual work plan for FY 2016/17 for all the counties. Both processes brought out the performance gaps across the health system as well as the priorities. The project also provided technical and financial support in development of SWG reports for Busia, Migori and Vihiga counties. The county teams used the ETR CHSSIP 1 and APR&P FY2016/17 report in development of the SWG.

Specifically, Migori county team adhered to the timelines and tools used in planning and budgeting. The county also developed the Sector working group report that detailed the program and sub-program priorities and budgets.

3 Results

The intervention realized a result on the change in county planning and budgeting systems. All the eight counties aligned the planning to the budgeting cycle. By having a rational review of the health sector achievements, seven counties: Kisumu, Migori, Homabay, Kisii, Busia, Kakamega and Vihiga counties identified priorities of focus for FY18/19 and areas to be addressed in FY17/18.

Involvement of the planning department in the training saw Busia, Vihiga and Migori counties utilizing the APR&P FY 2016/17 and the ETR of the CHSSIPs 1 in development of the county SWG reports. As of end of Jun 2018, all the counties had in place the county annual work plans FY2018/19.

A key result to all these initiatives was realized in Migori county as the County allocated Kes 1.96B in FY2017/18 compared to 1.86B in FY2016/17. Specifically, the HIV program was allocated 1.5M in FY2018/19 compared to the Kes. 0.5M in FY 2017/18.

4 Discussion

Strengthening the capacity of leadership and management teams in evidenced based decision-making and policy is a key component towards the achievement of sustained epidemic control initiatives. The devolved system of government on health service delivery provides a greater opportunity for technical teams in health management to engage with the teams tasked with the responsibility of allocating resources. The need to align planning and budgeting cycle is key in ensuring that county priorities are considered during budget allocation. The high HIV epidemic in sub-Saharan region and the decreasing donor funding calls for commitment by the government in prioritizing budget allocation for the HIV program.

Realization of the sustained HIV epidemic control has seen the national and county governments developing Aids Strategic Frameworks that spells out the strategic directions. One of the SDs is the need to increase domestic financing for sustainable HIV response. County led processes provides an opportunity for homegrown and county owned solutions to issues affecting delivery of services. The baseline assessment provided a means in which the project developed targeted interventions to address the gap in planning and budgeting.

The engagement of the county leadership from the onset of the assessment and implementation of the interventions; training on policy formulation and development of plans and budgets is a component that enabled Migori County to be on the road towards sustained epidemic control. The capacity on policy formulation and planning as well as aligning of the planning and budgeting cycles, will yield improved results with enhanced negotiation and advocacy skills of the leadership team. Similarly, engagement of the technical teams (county health management teams) and the political arm (county assembly health committee) enhances informed budget allocation.

Abbreviations

MTEF: Medium Term Expenditure Framework
LDG: Leadership Development and governance
AWP: Annual Work Plan
APR&P: Annual Performance Report and Plan
SWG: Sector Working Group Report
CDOH: County Department of Health
FY: Financial Year

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Towards Enhancing Quality of Routine Facility Mortality Data

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USAID Tupime Kaunti project

Background: Vital statistics are an important component of health information and essential for evidence-based planning and program improvement. In Kenya, availability and quality of routine vital statistics remains low. Mortality and cause of death data generated from health facilities in the country does not meet the World Health Organisation International Classification of Diseases and Related health problems, Tenth revision (ICD-10) standards. *Objective*: To enhance availability and quality of mortality and cause of death data in Counties, for planning and decision-making.
Methods: Tupime Kaunti project implemented a package of interventions at various levels of the health system. Regular offsite and on job training and mentorship on clinical certification and coding practises for County resource persons and health workers (certifiers and coders), sensitization and advocacy on cause of death data at County leadership and health facility management level, supportive supervision and data use forums
Results: Increase in reporting and availability of mortality and cause of death data in *District Health Information System 2 (*DHIS2), 72% (60) of health facilities trained reporting mortality data. Cause specific mortality data available in 70% of the 60 health facilities that reported deaths as at September 2018.
Conclusion: The critical value of mortality and cause of death data can be demonstrated through availing it routinely for public health decision making. The DHIS2 platform presents an opportunity to avail real time vital statistics centrally in Kenya. Holistic stakeholder engagement should be explored for sustainability of mortality and cause of death reporting.

Keywords: Mortality statistics, cause of death data, mortality reporting, ICD-10, DHIS2, Tupime Kaunti project

1 Introduction

Mortality and cause of death data are an important component of health information and essential for evidence based planning and program improvement. Countries need to know how many people die each year, in order to have well-functioning health system and to design effective public health policies. It is important that mortality information is not only collected on the numbers of deaths by age and sex, but also to be able to attribute death to its underlying cause (NASCOP, 2018). In Kenya, availability and quality of routine vital statistics remains low, prompting public health workers and researchers to search for alternative data sources. Mortality data generated from health facilities in the country does not meet the World Health Organisation ICD-10 standards. This is due to factors such as incomplete reporting and inaccurate definition of cause of death, inadequate capacity to certify and code deaths as per the required International Classification of Diseases standard, and little understanding among doctors on the importance of completing death certificates appropriately (Mahapatra, P., et al 2007). The International Classification of Diseases (ICD), produced by the World Health Organization (WHO), is the global standard diagnostic tool used to classify diseases and other health problems recorded through many types of health and vital records including the medical certificate of cause of death and hospital medical records. The Ministry of health, ICD implementation guideline (2014), provides a strategy to strengthening health information

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systems for proper reporting of every death at the facility including cause-of-death. Through the Ministry of health, there is a renewed drive to strengthen country's health information systems to ensure proper recording and reporting of every birth and death including cause-of-death data. Tupime Kaunti is working with County departments of health to strengthen health systems system for improved decision making, transparency and accountability in health.

2 Methods

The objective of the intervention was to address the limited use of ICD-10, enhance availability and quality of mortality data in County departments of health The intervention was conducted is eight counties that are focus counties for the Tupime Kaunti project. Health facilities were purposively selected based on provision of inpatient services, the volume of deaths and admissions per month reported by the records department. The selection of the health facilities was conducted consultatively with the county government department of health.

Tupime Kaunti project conducted a situation analysis in August 2017 to determine the status of mortality and cause of death reporting. Findings from the situational analysis, and the Ministry of Health ICD10 implementation guideline served as a reference material for the development of a technical approach to guide the interventions.

For ownership of activities, a county led approach was used to steer the interventions. County resource persons were nominated by the county departments of health to steer implementation of the interventions to strengthen mortality reporting and use of ICD-10 standard in certification and coding of deaths. The resource persons selected were trained certifiers and coders with passion in ICD-10, or previously trained as Training of Trainers (TOTs) by the Ministry of Health - Civil registration and vital statistics unit or at management level and thus able to provide mentorship and seek accountability from the health workers trained in ICD-10. The county resource person's role included training, mentorship, supportive supervision and advocacy for mortality reporting. An orientation on the Ministry of health, ICD implementation guidelines and the ICD-10 training material was conducted to equip the resource persons with the requisite skills.

To address the capacity gaps among the health workers, the project implemented various capacity building initiatives, these included training on ICD-10 and reporting in DHIS2 for certifiers and coders from 83 high volume health facilities. The project also trained coders on data manipulation including conducting basic data quality checks, analysis and presentation of cause of death data in MS excel. Post training mentorship and support supervision was conducted to all trainees to assess implementation and provide support where gaps were observed at the workplace. To reach a larger pool of health workers, continuous medical education sessions on ICD-10 were conducted in County referrals hospitals and some sub county hospitals based on the gaps observed during supervision.

To address organisational factors affecting uptake of mortality reporting in DHIS2 and data demand, the project oriented health managers from the county, sub county and hospital management teams on the value and use of mortality data. Managers play a key role in providing a supporting environment for sustainable implementation of ICD-10 interventions, as well as demand of mortality data. To trigger the demand for mortality data by the health leadership, advocacy forums with the County Directors and Ministers for health on the value and use of mortality and cause of death were conducted. To demonstrate use, mortality and cause of death data was integrated in health information products such as malaria bulletins, integrated health profiles and County annual performance reports.

3 Results

Two main data sources in the District Health Information System 2 (DHIS2) serve as sources for mortality data and will be used to explain the results. The Ministry of Health tool 717 (MOH 717) is the tool that contains summary data on work load in the health facility, and thus contains the numbers on total deaths reported. The DHIS2 event report contains patient level data on inpatient morbidity and mortality, this source contains cause of death data based on single entries conducted per deceased persons. Ideally, all deaths reported in the MOH 717 should be reported in the event module.

Seventy-two (72%, 60) of the health facilities trained by the project were reporting mortality data (workload/total deaths per month) by September 2018. Cause specific mortality data was available in 70% of the 60 health facilities that reported deaths in September 2018. Proportion of deaths reported with cause of death was 37% (442/1129) in 2017 to 52% (1783/3442) by September 2018. By September 2018, all (8) county referral hospitals were reporting cause specific mortality data in DHIS2 event report compared to 63% (5/8) in September 2017. County referral hospitals are the highest level of health service provision within the government health care structures, and represent the highest proportion of health service delivery and patient level data.

Atleast 50% of the 83 facilities trained were utilising ICD-10 in certification and coding of cases of death. One dimension of data quality that was reviewed for the cause of death data was completeness. Completeness was assessed by using one core data element in the sequence of cause of death; immediate cause of death. All counties reported completeness above 80% besides Kisumu county that had 43% completeness of cause of death data.

4 Discussion

There was increased availability of both mortality and cause of death data in the DHIS2 across all counties. Improved documentation and sequencing of causes of death in death notification (D1) forms by trained certifiers was observed in atleast 50% of D1 forms available in health facilities during supervisory visits. However, accuracy of the cause of death data had not been ascertained. Availability of complete cause of death data provides counties the opportunity to utilise routine data mortality data in public health planning (Sibai, A.M, 2004). This is evident from counties such as Vihiga county that has utilised cause of death data in performance review reporting, and in Kakamega where morality data is integrated in HIV program review meetings. Engagement of managers through orientation and during the implementation phase has yielded positive results. Managers have addressed challenges such as internet connectivity to facilitate data entry of mortality data in DHIS2. In Busia County Referral Hospital the health records and information office receives a monthly airtime allocation to facilitate data entry, while in Kisii teaching and referral hospital quarterly meetings to review mortality and cause of death data are steered by the county director of health.

Prior to Tupime Kaunti project intervention at the counties, various capacity building efforts on ICD-10 had been conducted by development partners. However, implementation uptake had been minimal. Further research and action on the factors affecting sustainability are pertinent to achieve the set objectives.

Varied challenges hinder optimum documentation and reporting of mortality and cause of death data at health facility level. This is compounded by the low value placed on routine sources of data collection by various stakeholders. The critical value of mortality and cause of death data can be demonstrated through availing it routinely for public health decision making. The DHIS2 platform presents an opportunity to address the need for a centralised data collection system for vital statistics in Kenya. Thereby addressing the gap of routine and real time data on vital events. Holistic stakeholder engagement should be explored for sustainability of mortality and cause of death reporting.

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Measure, monitor, mature: How to assess and improve health information systems (HIS) to achieve better health outcomes

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1 Introduction

A strong HIS that provides the right information at the right time to the right people in the right format is required to transform a nation's health. Despite a growing emphasis on strengthening HIS and measuring how they contribute to improved health outcomes, we don't know as much about the stages an HIS progresses through to increase its responsiveness to expanding demands for data. This knowledge gap underscores the need to understand the stages in the evolution of HIS, and assess the status of HIS, to direct efforts to improve them. Many HIS strengthening efforts at the country level are fragmented, and their implementation lacks coordination. This leads not only to duplication of data collection efforts but also to a fragmented picture of health and health services. Building standards-based, interoperable information systems facilitates data exchange and sharing between systems and across jurisdictions, reducing duplicative data collection efforts and enabling triangulation of different data sources. As the focus on strengthening HIS has grown within international development efforts, so has the desire to better understand the key components of HIS and interoperability, the stages of HIS improvement, and the associated interventions necessary to strengthen a country's HIS and ensure that its various components are interoperable.

2 Objective of Intervention

To address a gap in understanding HIS strengthening, MEASURE Evaluation, which is funded by the United States Agency for International Development, collaborated with the Health Data Collaborative Digital Health and Interoperability Working Group (HDC DH&I WG) to develop two toolkits: the HIS Stages of Continuous Improvement (developed jointly with the team at Centers for Disease Control and Prevention, Atlanta) and the HIS Interoperability Maturity Toolkit. The toolkits present a standardized approach to improving HIS, developing interoperability capabilities, and measuring progress across various stages and maturity levels.

The HIS Stages of Continuous Improvement identifies the major components and subcomponents of an HIS, five stages of continuous improvement, and the attributes associated with each subcomponent across the five stages. The HIS Interoperability Maturity Toolkit was designed to help countries design interventions to strengthen interoperability, to enable and sustain a strong national HIS capable of data exchange. Both toolkits help assess the status of a country in the HIS maturity continuum and lay out the attributes required to continue advancing towards a strong, resilient national HIS.

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3 Lessons learned

The HIS Interoperability Maturity Toolkit has already been adopted by Ghana and Uganda, and several other countries have expressed interest. The HIS Stages of Continuous Improvement Toolkit has been adopted by Uganda. Key lessons have emerged from the development of both toolkits and their early adoption. The needs of countries currently working to strengthen their HIS are driving the development and adoption of these two toolkits. Countries participating in the HDC DH&I WG expressed the need to assess the status of, and develop improvement roadmaps for, efforts to build strong HIS that are capable of exchanging data and enable data use. Countries are eager to understand the current stage of their HIS and the steps necessary to reach the next stage of maturity. Both toolkits address this need by providing a matrix that outlines key domains of HIS and interoperability and the attributes of growth across five levels. It is crucial that countries wishing to assess their HIS, and its capacity for interoperability, convene a multi-sectoral group of HIS stakeholders from across the domains and sectors described in these toolkits to develop a common understanding of current gaps along with a roadmap for improvement. These models establish a standard language to discuss HIS strengthening interventions, and this standardization will allow more coordinated efforts and investments from countries, the international development community, and other actors supporting HIS strengthening.

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Evaluation of Implementation Models in use for multiple Health Management Information Systems in Kenya

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Background: Health facilities find themselves with a need to use multiple systems to meet different needs including clinical, administrative and finance. However, little has been done to evaluate the model they are using in selecting systems that will ensure interoperability and improvements over time. Most health organizations tend to lean towards hospital wide health information systems, which need to be designed in a way that data and information will be exchanged easily and efficiently. There are already established standards that seem not be adhered to, this study intends to explore and describe why such standard are not followed when designing health information systems. Since health executives interact with information and information systems in such areas as general accounting, financial planning, personnel administration and facility planning on a daily basis, need for seamless systems integration and data exchange is key. Predominant model for maintaining health care information has shifted from the current, largely paper based medical record system, in which information is often incomplete, illegible or unavailable where and when it is needed, to a system in which the patient's clinical information is integrated, complete, stored electronically and available to the patient and authorized persons anywhere with the facility network anytime regardless of settings in which services are provided.
The data about our care is not routinely shared across the organizations that provide patient care and accompanied subsystems, leading to providers not fully aware of certain patient conditions like allergies, clinical findings and history recorded in previous visits in different locations, leading to medical errors, inefficiencies, compromise on patient safety and even lead to death because of wrong prescriptions. However, solution to this is the application of medical information exchange to perform health care data transactions, and use of integrated delivery systems which reduces fragmentation which attempt to pull together diverse types of health care organizations and use information systems to integrate data from those organizations.

Objective: To assess the implementation models in use by health care organizations in Kenya in selecting and implementing multiple systems.

Study design: Mixed method approach, qualitative methods, interviews, focused group discussions and supplying questionnaires to respondents for filling.

Setting: Four health care organizations will be in use, two public and two private health facilities in Nairobi Kenya. Public facilities will be referral hospitals and private facilities will include bigger health facilities that will match public ones.

Subjects: This will include leadership, health facility management, system users and technical team that advises the organization for system procurement.

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Methods: Qualitative snowball approach will be used, guided by well accepted implementation model to understand the current implementation models in use. Semi-structured or group interviews, guided interviews and current system architecture assessment will be used.

Data management and Analysis: Analysis will lead to usable and useful information that will lead to improvement of standard adoption for system interoperability in health organizations. It will involve identifying common patterns within the responses and critically analyzing them in order to achieve research aims and objectives. Statistical packages, spreadsheets and presented using tables, graphs and qualitative data analysis tools.

Conclusion: To understand the different and current models in use during selection and implementation of health information systems in public and private health care organizations in Kenya, and identify opportunities for improvement; this will lead to consideration of system development guidelines and frameworks being adhered to. Health information exchange is key for sharing and exchanging of patient information across other systems within the health organization, which will lead to comparative data which combine external and external data to aid health organizations to improve patient care and safety at the same time evaluate their performance. Overall, better information means better care, accurate and complete information and reduce medical errors that could lead to loss of life.

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Design and implementation of an integrated health information system in peri-urban Dagoretti, Kenya

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Introduction

Globally, there has been an increase in use of Health information systems replacing the old paper-based system. This has majorly been because of the elaborate and significant advantages of digitizing health records. This paper describes the process of design and implementation of a health information system to be used in St. Joseph, a private mission hospital in peri-urban Dagoretti area in Nairobi, Kenya.

Objectives

The goal was to provide the facility with a single integrated system that will enable them manage all aspects of the facility ranging from medical records, finance management, lab, pharmacy and stock management. Our main targets were to: improve longitudinal patient care, improve operational efficiency in the rather understaffed facility, improve data capture accuracy, data extraction and reports generation. For this implementation, we used Bahmni, an open-source EMR and hospital system developed by *ThoughtWorks*.

Discussion

This paper discusses the entire process of design and implementation of a health system for St Joseph hospital. We discuss the procedures and tools used in conducting the initial facility assessment, the development strategies we employed and the challenges we experienced, the process we undertook in doing a network assessment exercise and the criteria we used in selecting the hardware to be used during deployment. Our experience through the period of implementation has enabled us to clearly define strategies, tools and techniques to apply during facility assessments and requirements gathering. Our experience also reinforced the need to design with the user and suggest the feasibility of using health systems in lowly resourced facilities.

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The Impact of an SMS-based Reporting System for Monitoring National Stock-out of HIV Commodities at Public Health Facilities: A Case of Uganda.

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Background: Stock-out of HIV commodities such as anti-retroviral therapy (ARV) and test-kits may prevent countries from reaching the 90-90-90 targets. To achieve the targets, Uganda has implemented guidelines which endorse the test and treat strategy. With support from the Center for Disease Control and Prevention and Makerere University School of Public Health, the Ministry of Health (MoH) implemented a reporting system based on short message service (SMS) of data on two HIV commodity indicators which are sent by health workers through their mobile phones to the central server at MoH. The reported stock-out data is used to trigger prompt action to deliver the commodities. We describe the impact of implementing a SMS-based reporting system for monitoring national stock-out of HIV commodities at public health facilities in Uganda.

Methods: To determine the impact of the SMS-based reporting system, we performed a retrospective cohort analysis of data on stock-outs of HIV test-kits and ARVs reported from 1,700 health facilities across the country. We compared stock-out levels reported in 2014 (baseline) to those reported in 2015, after complete operationalization of the system.

Results: The proportion of health facilities reporting stock-outs of HIV test-kits reduced from 22.5% in 2014 to 16.4% in 2015. Similarly, the proportion of health facilities reporting stock outs of ARVs reduced from 46.1% in 2014 to 40.9% in 2015.

Conclusion: The SMS-based reporting system for stock-out of HIV commodities led to a considerable reduction of stock-outs of HIV test-kits and ARVs in public health facilities in Uganda. This low cost-effective innovation should be adopted by other countries in Sub-Saharan Africa for effective monitoring of HIV commodities.

Keywords: Key words: SMS-based system, HIV commodities, Uganda

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Equity Lens for Global Health: A Case Report of Medic Mobile's Equity Toolkit for detecting inequities in local health systems and influencing equitable care delivery

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Background and Purpose: The purpose of this case report is to explore the concept and process of implementing the Equity Lens approach using Medic Mobile's tools for assessing equity in local health systems.

Methods: The pilot Equity Lens program was implemented at three Living Goods branches in Kenya. Utilizing a new family equity survey incorporated into the Medic Mobile app, Community Health Providers (CHPs) collected socio-demographic information necessary to calculate Wealth Quintiles (WQ) for households within their catchment areas. Health indicators were identified for prenatal care, antenatal and treatment of childhood illness cases. Using comparison and regression statistical methods, data was analyzed to describe patterns of health equity across and within the pilot branches.

Results: The family equity survey had 90% coverage resulting in data on 41,280 households and 75,315 patient encounters, with most households (55%) falling within the bottom two WQs. Results summarized which indicators met organizational targets and the equity profile. For many indicators, no health inequities were found; for others, however, clear wealth disparities existed at the community level.

Conclusions: A pilot Equity Lens program provided meaningful information to stakeholders who are making decisions about resource allocation and CHP workflow and opened the conversation about health equity as a priority target within a global health context. Providing real-time transparency of household wealth could help guide and incentivize CHP delivery of care where and when it is most needed.

Keywords: First keyword Health equity, Second keyword Health technology, Third keyword Disparity

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Learnings from digital innovation for health equipment management and maintenance systems for Kakamega County health facilities in Kenya.

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Background and Purpose: Health technologies, particularly medical devices, are essential in supporting equity in access to health services and improved quality of health services. A core challenge remains for health facilities in the less developed regions of Kenya, where there is sub-optimal use of medical equipment due to overall weak management; limited numbers of biomedical engineers; lack of inventory systems, asset registers, maintenance plans and systems and absence of equipment disposable mechanisms. In Kakamega County, health equipment data is stored in manual based siloed records, making access to updated records challenging.

Methods: Through a co-creation solution development and implementation approach, Kenya National and Kakamega County Ministries of Health, UNICEF Kenya and Philips are implementing an intervention aimed at leveraging mobile and web-based tools to accelerate processes in health equipment management, for improving maternal and child health services indicators.

Results: In 3 days, trained county field teams collected data from all its 163 public health facilities and provided the first digital baseline view of health equipment in Kakamega County. Data on 13,000 equipment was captured through the mobile application. 269 of the data collection staff were nurses, biomedical engineers and technicians, clinical officers, health records and information officers, laboratory technologists and technicians, doctors, occupational and physio – therapists, procurement officers and health administrative officers.

Conclusions: Contextualized digital tools can be developed and used to support data collection by different county healthcare staff cadres for improved decision making related to health equipment management in limited resource contexts, in a time effective manner.

Keywords: Biomedical Engineering, Mobile Applications, Decision Making, Child Health Services

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Building health informatics systems interoperability solutions development for emerging markets, a review of Philips' Phoenix platform.

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Background and Purpose: Health information solutions in emerging markets at a primary health level are highly fragmented and do not provide a comprehensive view of care. Several stand-alone devices and solutions exist, that are not scalable and are specific to a geography, making them difficult to replicate elsewhere. Philips is addressing these challenges through a platform approach. Phoenix digital platform is part of the Information Technology (IT) solutions within Philips' Community Life Center (CLCs) approach, a modular, integrated and interoperable healthcare ecosystem for linking primary care into a connected system.

Methods:
Various co-creation workshops with key opinion leaders and field visits to different emerging markets demonstrated need for a context relevant, robust, integrated and interoperable IT platform. To build it, Philips team landscaped the solution space and curated a set of modular open source assets, proven at scale. Phoenix supports well-known healthcare standards like Fast Healthcare Interoperability Resources (FHIR) and Digital Imaging and Communications in Medicine (DICOM).

Envisioned Results:
Such a platform for the emerging markets will: provide modular infrastructure services required to develop m-Health and e-Health applications; provide care management services to deploy relevant care plans; collect data from connected healthcare devices with relevant health facility IT systems; enable reporting to systems like District Health Information System2 (DHIS2); enable referral across health facilities and support the home-based care delivery.

Conclusions: It is imperative to take a "platform approach" to support integrated, interoperable propositions for strengthening patient care and healthcare decision making within and beyond primary healthcare level.

Keywords: Information Technology, Ecosystem, Referral and consultation

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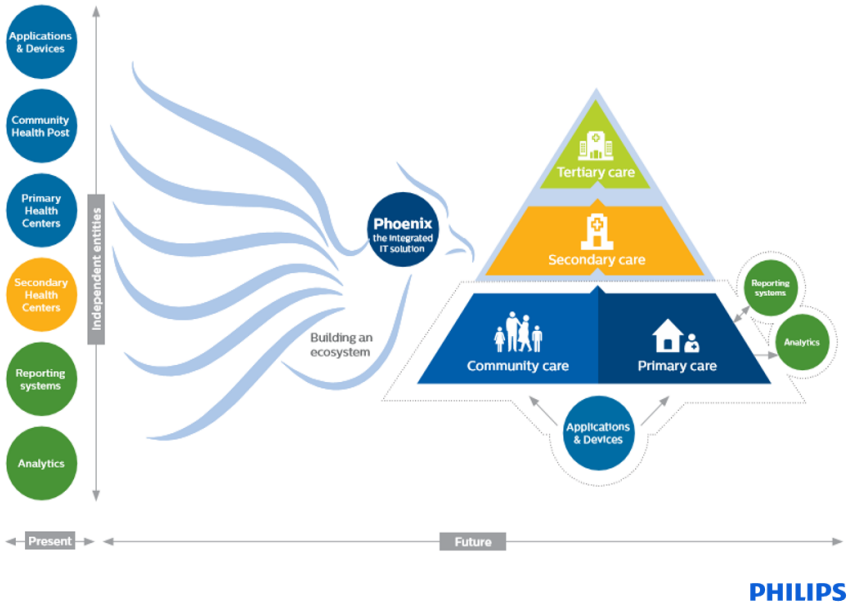

Figure 1. Phoenix IT Platform Overview

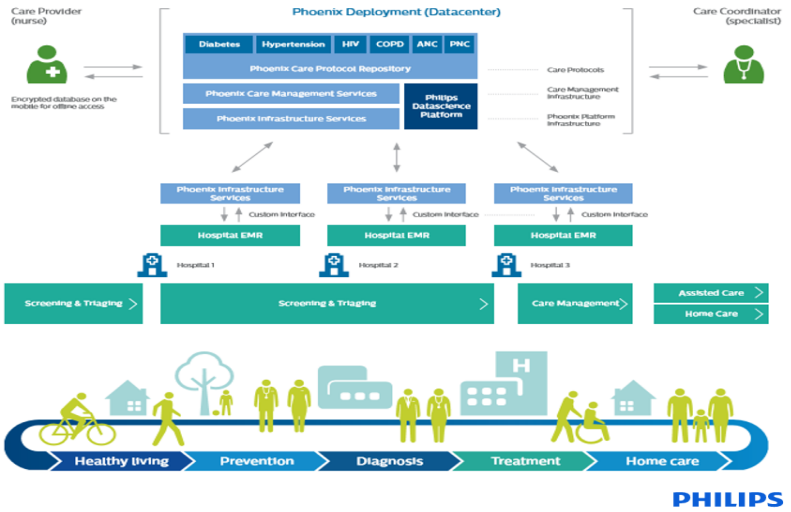

Figure 2. Phoenix Deployment (Hub and Spoke Mode)

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Data Review meetings: A Foundation for Evidence Based Interventions

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One of the objectives of the National Malaria Strategy is to strengthen surveillance, monitoring and evaluation systems so that key malaria indicators are routinely monitored and evaluated in all malaria endemic and epidemic counties. Vihiga County is one of the lake region malaria endemic counties with the highest malaria positivity rate in Western Kenya. Malaria is the leading cause of both mortality and morbidity for all ages and contributes 17.6% of all deaths[1] and about 35% of all out-patient cases with fever test positive for malaria[2]. A county malaria data review meeting in September 2017, identified data gaps including; discrepancies between confirmed positive malaria cases and suspected cases reported in DHIS2, knowledge gaps among the health care workers on malaria surveillance indicators and non-standardized data collection tools at outpatient department.

To address the gaps and to improve access to quality malaria data for program management and planning, the USAID- Tupime Kaunti project conducted malaria data review at facility, sub-county and County levels. The project also supported key health managers who are crucial in malaria programing either at the county or sub county level to develop DHIS2 malaria dashboards in their personal DHIS2 accounts for ease of access to the information and real time tracking of performance.

Because of the mix of interventions employed by the project, the quality of malaria data has improved over time as shown in the analysis below comparing Oct 2017 – Oct 2018 and Jan 2017 – Sept 2017.

1 Introduction

Vihiga is among the Counties with high malaria burden and according to the epidemiological zoning, the county is within the malaria endemic regions of Kenya, where malaria transmission is constantly high throughout the year. Clinically diagnosed malaria is responsible for 30 per cent of outpatient consultations, 15 per cent of hospital admissions and 3–5 per cent of inpatient deaths in Kenya3. For substantial reduction of malaria cases and mortality as a step towards elimination, the lake endemic counties need to strengthen evidence based malaria control intervention. This will only be possible if the counties are able to utilize data that is of good quality in decision-making.

Failure to consider empirical evidence regularly before making program and policy decisions is due primarily to the complex causal pathway between data collection, its use, and improvement in health outcomes4. To data demand and use, MEASURE Evaluation cites eight key activities that need to be in place: i) assess and improve data use context ii) identify and engage data users and data producers, iii) improve data quality, iv) improve data availability, v) identify information needs, vi) build capacity in data

[1] Mortality study report, 2018
[2] DHI2 – April 2018
[3] Kenya National Malaria Strategy 2009-2018
[4] Improving data use in decision making- An intervention to strengthen health systems – Measure Evaluation

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use core competency, vii) strengthen organizations data use infrastructure and viii) monitor, evaluate and communicate results of data demand and use interventions. These interventions can be implemented as a whole package or as part of the on-going initiatives to strengthen data demand and use in an organization. This paper puts three interventions into context: i) engagement of data users and producers (data reviews), improving data quality and building capacity in data use core competencies.

To improve the quality of data, all the players (data producers and data users) should be engaged to ensure that data implementation of quality initiatives. In this context data producers design, implement and manage health information systems (health records and information officers, M&E officers) whereas data users (program officer) utilize data in program management and planning. An individual can collect, analyze, synthesize, interpret and use data but most commonly, individuals at different levels in service delivery do them. The interaction therefore offer data producers and data users room for all to understand the data collection processes, methods and tools used, and their effect on the quality of data generated. It also provides room for the team (users and producers) to identify information that speaks to the gap in service delivery.

Tupime Kaunti Project is mandated by PMI/USAID to work with counties to ensure routine monitoring, evaluation and reporting of malaria data as per objective 4 of the Kenya malaria strategy 2009-2018 which aims at ensuring that all malaria indicators are routinely monitored, reported and evaluated in all counties by 2018. Some of the strategies employed by the project embrace building the capacity of the County Malaria Control Coordinators from the malaria lake endemic counties on monitoring and evaluation of malaria program, data quality assessment & improvement and advocacy for resource by county governments towards malaria prevention. The objectives of the intervention was to;

(a) Engage data users and data producers
(b) Build capacity of the team on data management processes
(c) Improve quality of data

Overtime, effective monitoring of malaria trends in Vihiga County has been hindered by lack of complete and accurate data to compare outcomes of the implemented interventions. Programmatically, some of the data quality gaps identified through data reviews meeting include high number of malaria cases confirmed positive contrary to number of cases suspected for malaria.

2 Method

To address the gaps and to improve access to quality data for malaria program management, Tupime Kaunti Project supported select facilities, sub-counties and County levels data review meeting and developed Performance Improvement Plans (PIP) in collaboration with implementing partners. The project also supported malaria control coordinators and Health Records &Information Officers from county and sub-county to develop DHIS2 malaria dashboards in their personal DHIS2 accounts for ease of access to the information and real time tracking of performance.

2.1 Selection and Description of Participants

Vihiga county department of health in collaboration with Tupime Kaunti project selected key participants involved in data production and use from different levels:

County level:

- *County Malaria Control Coordinator (CMCC):* the CMCC identifies key indicators for data review in line with the National Malarial Strategy, in collaboration with the CHRIO and develop data review templates. The CMCC further oversee the presentation, documentation of best practices, identification and implementation of priority action for Performance Improvement Planning.
- *Monitoring and Evaluation Officer:* The M&E officer provides technical support to CMCC in identification and aligning of indicators to the County Health Sector Strategic Plan, Annual Work Plan and in determining the best means to measuring performance.

- *County Health Records and Information Officer (CHRIO*): The CHRIO in collaboration with CMCC provide guidance and coordinates data mining by Sub-County Health Records & Information Officer (SCHRIO). The CHRIO also oversee implementation of data quality improvement actions from data review meetings.

Sub-county level:

- *Sub-County Malaria Coordinator (SCMCC):* the SCM are responsible for interpretation and presentation of finding on key indicator identified for data review. The SCMCC also responsible for identification and implementation of interventions towards addressing gaps identified during data reviews.
- *Sub-county Health Records and information Officer (SCHRIO*); the SCHRIOs are responsible for mining data from DHIS2 and other sources, analysis and visualization according to the data review template provided by CMCC. The SCHRIOs are also accountable for implementing data quality improvement plan from data review meetings.

Health facility level:

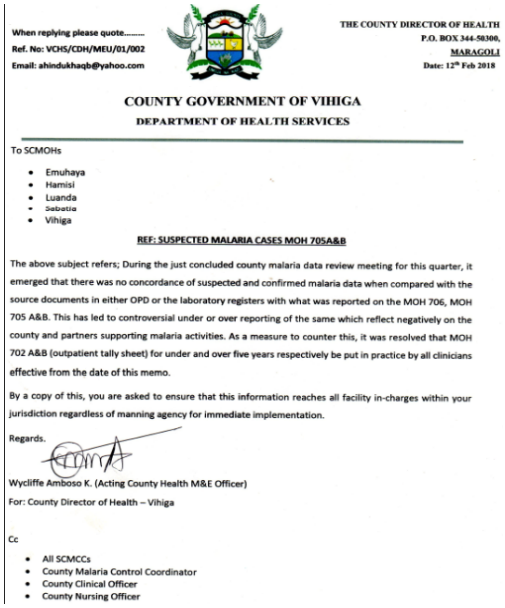
Health facility in-charge: Facility in-charges are in control of resources, including human resource, and overall implementation of facility performance improvement plans.

2.2 Technical Information, Dashboard development

To first enhance the capacity of the program officers and HRIOs in using dashboard functionality in DHIS2, the project provided technical support to the team on; identification of priority indicators and development of a dashboard. Use of evidence in decision-making starts with one identifying the key issues to be addressed or key objectives that one strives to achieve. The County and Sub-county teams identified the key priority indicators of interest among them suspected and confirmed malaria cases with the intent of knowing the malaria positivity rates. Through this forum the team noted an issue in the figures reported as the confirmed cases were more than confirmed cases. A dashboard on the same was generated within the DHIS2 platform and was shared amongst the county leadership and malaria control coordinators.

2.3 County Data review

A data review conducted in the county brought out the issues and the challenges around the gaps were cited by the teams supporting malaria activities. Once of the gaps noted was the misunderstanding on data collection tools as well as data capture in DHIS2. A couple of actions were developed and among them were: a directive from the county in a form of a memo (Figure 1) to the health facilities on how to capture two indicators; and the need to conduct data reviews at the facility levels while providing targeted on job trainings.



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Email: ahindukhaqb@yahoo.com

THE COUNTY DIRECTOR OF HEALTH
P.O. BOX 344-50300,
MARAGOLI
Date: 12th Feb 2018

COUNTY GOVERNMENT OF VIHIGA
DEPARTMENT OF HEALTH SERVICES

To SCMOHs

- Emuhaya
- Hamisi
- Luanda
- Sabatia
- Vihiga

REF: SUSPECTED MALARIA CASES MOH 705A&B

The above subject refers; During the just concluded county malaria data review meeting for this quarter, it emerged that there was no concordance of suspected and confirmed malaria data when compared with the source documents in either OPD or the laboratory registers with what was reported on the MOH 706, MOH 705 A&B. This has led to controversial under or over reporting of the same which reflect negatively on the county and partners supporting malaria activities. As a measure to counter this, it was resolved that MOH 702 A&B (outpatient tally sheet) for under and over five years respectively be put in practice by all clinicians effective from the date of this memo.

By a copy of this, you are asked to ensure that this information reaches all facility in-charges within your jurisdiction regardless of manning agency for immediate implementation.

Regards.

Wycliffe Amboso K. (Acting County Health M&E Officer)
For: County Director of Health – Vihiga

Cc

- All SCMCCs
- County Malaria Control Coordinator
- County Clinical Officer
- County Nursing Officer

Figure 1. Memo to health facilities

To inform the targeted health facilities a dashboard was developed in DHIS2 and a sample is as shown in figure 2. The dashboard guided the participants on the facilities with highest cases of suspected malaria cases in comparison with the confirmed cases. The process involved the SCMCCs, the SCHRIOs, the health facility in-charges and the health facility HRIOs where they were available.

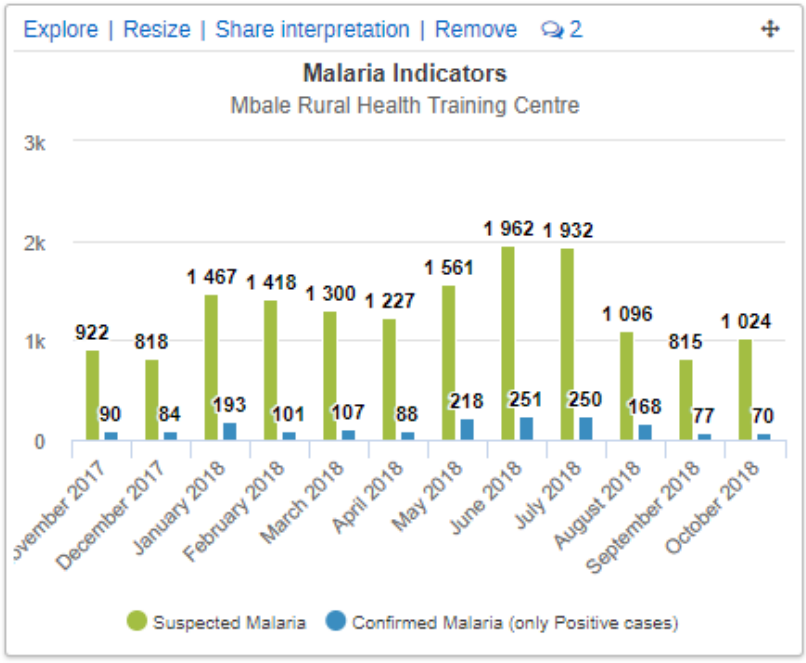


Figure 2. Sample DHIS2 facility Dashboard

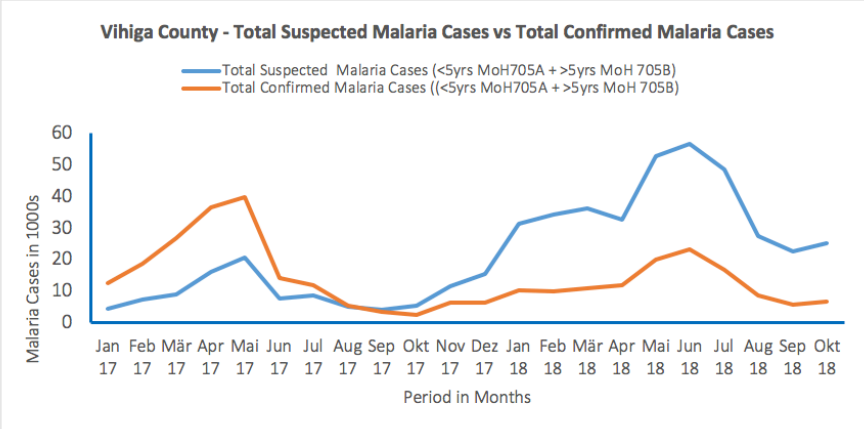
2.4 Health facility data reviews

To facilitate the data reviews, the SCMCC and SCHRIO shared an extract of the data reported in DHIS2 with the health facility team. Key to the discussion was the tools used to capture and tally data at the facility;

Tally sheet was discussed as a source of the suspected malaria cases, confirmed was captured through MoH 204A (for the under 5 years) or MoH204B (for the over 5years) that was verified through the MoH706 lab register. Further to the discussion was how the team determined what was reported in the health summary tools MoH705A (for the under 5 years) and 705B (for the over 5 years). The review also provided an avenue for the team to provide on-job training on data sources, reporting and using the two critical indicators.

2.5 Statistics

After the field support through the data reviews and on-job trainings, there is a change in the data reported in DHIS2. The chart below shows an improvement in reporting number of cases suspected for malaria compared to the cases confirmed positive for the period September – December 2017.



3 Discussion

Evidenced based decision-making is a critical component in an institution planning and program management process. The close collaboration between the project and the Vihiga county health management teams provided a foundation for improvement on quality of data. The investments made to ensure availability of data through DHIS2 is not enough to inform evidenced based interventions. Regular data reviews through engagement of data users and producers in prioritization of key issues affecting health programming is critical to ensuring sustainability of data quality and use interventions. It is also important to have the county leadership taking lead in these initiatives as it ensures that systems can eventually align to the data quality initiatives. It is also important to have all the players (M&E officers and HRIOs and program officers) understand the gap in data collection and reporting and agree on the role of each player in improving data management processes.

4 Conclusion

Data review meetings propel individuals at different levels evidence-based interventions to play their role in improving quality of data.

Abbreviations

MoH; Ministry of Health
HRIO; Health Records & Information Officer
M&E; Monitoring & Evaluation
DHIS; District Health Information System
MCC; Malaria Control Coordinator

Disclaimer: "This abstract is made possible by the support of the American People through the United States Agency for International Development (USAID.) The contents of this abstract are the sole responsibility of the author."

Acknowledgments

The authors would like to thank county departments of health for the positive reception of the project initiatives and for commitment towards improving evidenced based policy development and implementation. They also thank USAID Tupime Kaunti project for providing an opportunity to facilitate and implement the project initiatives. Finally, they are indebted to the project leadership; chief of Party - Lilian Mageto and Deputy Chief of Party Hesbon Ooko for the guidance and support.

Competing interests: None.

Ethics approval: None

Provenance and peer review: Not commissioned; externally peer reviewed.

Reference

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Institutionalizing Measurement Learning and Accountability systems

Hesbon Ooko, Gititu George, Okello Bernard, Nyaboga Joyce , Nyarotso Carol

Tupime Kaunti Project

Introduction

In planning strategy to strengthen the Measurement Learning and Accountability system in the health sector, a critical step lies in conducting a systematic baseline assessment of MLA capacities in order to provide quality data and synthesized information for planning, implementation, policy development, and decision making. Measurement Learning and Accountability is key in strengthening Health Information System and structures in the county for a strong monitoring and evaluation of health interventions. To enhance monitoring and evaluation system for improved decision making, transparency and accountability in health, baseline assessment and development of quality improvement action plan is key in addressing MLA gaps. Institutionalization of quality improvement plans within county strategic policies and plans, allow prioritization for ease of implementation, monitoring and follow up.

Objective

To build county ownership and institutionlization of MLA systems

Intervention

To achieve the project goal of one functional, sector wide monitoring and evaluation system for improved decision making, transparency and accountability in health, USAID-Tupime Kaunti project facilitated Kakamega, Busia, Bungoma, Vihiga, Kisumu, Kisii, Homa Bay and Migori to conducted an assessment on Measurement Learning and Accountability (MLA) capacities. The assessment was conducted through mixed method approach utilizing different capacity assessment tools. The assessment focused on Leadership and Governance, Finance, Work force, Coordination and networking, Information management and Data and information use. An MLA strengthening action plan was developed by the county to address gaps across all domains. The Leadership Development and Governance Group monitored the system-strengthening plan quarterly. Furthermore, majority of the activities arising from the plan have been integrated into the county Health Sector Strategic Plan and Annual Work Plan thus Institutionalization in county plans and are being monitored.

Lesson learnt

To institutionalize MLA system strengthening action plan, there must be ownership of the plan by the county department of health core leadership and stakeholders. All improvement plans should be anchored within the department annual work plan for its prioritizing and implementation. Further, institutionalizing monitoring of MLA system strengthening plan will be achieved by anchoring it as part of LDG ToR and building LDG capacity to conduct self-monitoring with minimal technical support

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Enhancing Quality of Malaria Data for Improved Malaria Programing through Engaging Data Producers.

Lilyana Dayo[2], George Wadegu[2], Karen Owuor [*], Alfred Oginga[1], Dickens Onyango[2], Hesbon Ooko[2].

[1]County government of Kisumu, department of health
[2]Tupime Kaunti Project.

Introduction

Sound decisions are based on quality data making it essential to ensure that available data is of good quality. Kisumu County Department of Health utilizes health-facility data, which constitutes a primary data source for assessing the performance of the health sector. The department has prioritized malaria which is the leading cause of morbidity in Kisumu County. However, poor quality data has hampered its use for evidence based planning and programing. The poor data quality could have been as a result of poor data management practices, lack of understanding of malaria indicators, lack of use of data at the facility level before transmitting to the next level, poor culture of data use for decision making among others. The County health department with the technical and logistical support from USAID-Tupime Kaunti project, put in place interventions to address these gaps.

Objective

To improve the quality of malaria for informed decision making

Interventions

To address the gaps, the county with support from USAID Tupime Kaunti, facilitated facility specific malaria data review, sub county malaria data reviews and Data Quality Audits (DQAs). During the data review meetings, the data producers were sensitized on the importance of good data management. They were also taken through the process of analyzing and visualizing their data for purpose identifying gaps. The identified gaps were prioritized and action plans developed to address them. The DQAs sessions provided an opportunity to address the data inconsistencies that were being generated and reported by the data users. For instance, facilities were reporting higher numbers of malaria tested cases than suspected cases. This was contrary to the malaria treatment guidelines which require that the tested malaria cases should be identified from the pool of suspected cases. The DQAs however identified that the data producers did not understand some of the data elements and were wrongly documenting in the primary data collecting tool. This error was escalated to the next level of reporting.

Lesson learnt

Engagement of data producers at the facility level has had a positive outcome on the quality of malaria data being generated and transmitted to the next level. Building the capacity of data producers in analyzing their data and using the same for informed decision making enhances the culture of data use.

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Towards a Seamless HIS from Community to National Level: Case of DHIS Tracker

Jens Kaasbøll, Chipo Kanjo, Mari Iversen

University of Oslo, Norway

"Strong health systems are central to achieving better health outcomes, and strong health information systems (HIS) are the backbone of strong health systems. A properly functioning HIS gets the right information into the right hands at the right time, enabling policymakers, managers, and individual service providers to make informed choices about everything from patient care to national budgets" (Measure,**). Until recently, the Malawi HIS was mostly capturing data from health facilities to national level; excluding the community level where community health workers (CHWs) operate. The CHWs in Malawi make 30 % of the health workforce, with a core aim of connecting the communities and the national health sector. CHWs provide curative, promotive and preventative care. The services that the CHWs provides include operating the village clinic service and household visits where they walk around and provide health services where the people live. Their job consists of a various set of activities, ranging from primary health care, disease surveillance, to health awareness/promotive talks.

For a long time, the CHWs were capturing their data manually using paper and pen. In recent years, this trend has changed as there has been a new wave of global interest, with many players focusing on how to ease the CHWs workload by providing mobile-based applications to use for data capturing. Despite some of the challenges, (i.e. some of these health applications use their own database which leads to duplication of data and incoherent databases outside the national health information system); these mobile-based applications have allowed for a seamless solution to data flow from community to national level. This has improved the quality of health information and promotion of the meaningful use of health data to support and ground decision-making. Further, the mobile-applications empowers the CHWs to come up with sound decisions on how to handle the different cases they encounter as they save communities. CHWs are able to advise, diagnose and treat.

In this paper, we use an android based data capturing system for CHWs that was piloted in Malawi over a period of 2 months. The system is aims to substitute all the paper-based registration forms used by the CHWs. The system was configured in DHIS2. DHIS2 is a free and open source software with several modules used for validation, collection, analysis, and presentation of aggregated and patient-based statistical data. The DHIS2 allows the implementers to create and customize information systems through an open meta-data model. The data is stored on a national server. DHIS2 Tracker capture module for android was used. Tracker capture is a configurable multiple event program that allows you to capture client data, even without internet connectivity. DHIS2 is used as the national HMIS hence it is easier to integrate the tracker capture and transfer data from it. This provides for a seamless data flow from community to national level.

Having all community data in one system relieves the CHWs from having separate apps and phones for the 15 health programmes they are working on.

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Medical Sensors for Non-Communicable Disease Detection in Low Resource Settings

Jens Kaasbøll, Chipo Kanjo, Mari Iversen

University of Oslo, Norway

Medical Sensors for Non-Communicable Disease Detection in Low Resource Settings

Until recently, there has been little focus on prevention, cure and management of non-communicable diseases (NCDs); largely because they are not transmissible (Gamage and Jayawardana, 2018) and generally have slow progression. Further, for most of the 20th century, NCDs were considered as problems primarily of high-income countries, or mainly affecting the elderly, for which there was little that could be done to intervene as they were part of the normal ageing process. However, research has shown that NCDs kill more than 36 million people annually, of which 29 million occur in low- and middle-income countries (Alwan and MacLean, 2009; NORAD, 2014). For example, Diabetes alone is increasing rapidly in people of South Asian, African, and African Caribbean origins (Oldroyd, et al., 2005), with a 12% prevalence rate in urban Kenya (Christensen et al., 2009). In view of this, WHO made a call to have a comprehensive approach requiring all sectors to work together and reduce the risks associated with NCDs (WHO, 2011). This is where digital health comes in as it can assist in developing health surveillance systems used to detect and monitor NCDs. mHealth4Afrika App is one of the digital health systems that integrates EMR & EHR functionality, whilst utilising medical sensors and plays a huge role in detecting NCDs.

mHealth4Afrika App

mHealth4Afrika App is a co-designed, open source, multilingual mHealth platform developed to improve primary healthcare delivery in resource constrained environments where there is a general shortage of medical equipment. It is implemented in urban, rural and deep rural health clinics in Southern Africa (Malawi, South Africa), East Africa (Kenya) and Horn of Africa (Ethiopia). The App support maternal and newborn healthcare delivery by capturing patient profile, medical history, obstetric history, and clinic appointments through a number of programs. Special focus is put on detection of NCDs such as diabetes, hypertension through use of sensors. The programs include: Maternal Program (Antenatal Care, Delivery, Postnatal Care, Family Planning); Child Under 5 Program (Growth & Nutrition, Childhood Illnesses, Immunisation).

Sensor Utilisation in mHealth4Afrika App

Today, most medical services rely on sensors to aid in accurate monitoring, diagnosis and treatment. Dr. Eric Topol, a renowned digital health guru, name sensors as one of the top technologies that could change medicine. The sensors are particularly important as they facilitate non-communicable/chronic disease management (Larkin, 2014). Where medical equipment is available, it is common and recommended practice to give a physical examination to all patients, i.e checking the blood pressure, temperature, diabetes etc. However, in most rural and deep rural settings in low resource settings, availability of such resources is not guaranteed. mHealth4Afrika App has incorporated utilization of reasonably-priced sensors to aid in the detection of NCDs in these resource poor settings. The sensors help in physical examination and various

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diagnostic tests. mHealth4Afrika1 engages with health workers sensitizing them on the use of sensors to take readings.

Conclusion

"NCDs and poverty create a vicious cycle whereby poverty exposes people to behavioural risk factors for NCDs" (Mendis and Alwan, 2011: pp.6); therefore, availability of ways and means of detecting NCDs in the poverty-prone areas is crucial.

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Semantic Interoperability: Localizing an international messaging standard (HL7) to facilitate interoperability between systems in Kenya

Teddy Brian Odhiambo, Mwenda Gitonga, Joseph Njunge, Danielson Onyango, Joshua Oiro, Jacob Odhiambo

Palladium Group

Background

Functional interoperability is lowest level of data exchange between systems; no interpretation of data by the receiving system occurs; Structural interoperability builds upon this to describe the format of the data exchanged. Semantic Interoperability, highest level, builds on this by enforcing codification and shared vocabularies allowing systems interpret data unambiguously.

Methodology

An Interoperability Layer (IL) was developed to enable seamless flow of patient data across Electronic Medical Records (EMRs). Message profiles were defined as a key step to enable semantic interoperability; a module was developed to validate the message structure and vocabulary.

A team of Hl7 and HIV care experts defined message profiles for sections of the HIV treatment continuum. The developers sought a structure that was expressive, and easily programmable unlike the pipes and carats in Hl7.

Results

JavaScript Object Notation (JSON) was selected as the message structure; due to its large developer support, it was easier for most developers to consume and produce the message profiles.

For the shared vocabulary, the MOH green card was adopted and its values codified. Message profiles were defined based on HL7 v1 for Patient Registration (ADT^A04), Patient Update (ADT^A08), Appointment Scheduling (SIU^S11), Pharmacy Order (RDE^001), Pharmacy Dispense (RDS^O13), Lab Order (ORM^O01) and Observation Result Unsolicited (ORU^R01).

Conclusions

HL7 message profiles was the basis of communication between HIS. Any system that could produce and consume these message profiles, did not have to recreate interoperability solutions for new cases making it easy for new systems to join the exchange. For successful interoperability, the messaging standards and vocabulary used must be localized to ensure buy-in.

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Leveraging the National Data Warehouse (DWH) for efficiencies in estimating national ART cohort outcomes for patients receiving ART at health facilities using Electronic Medical Records (EMR) in Kenya.

Jacob Odhiambo, Mwenda Gitonga, Joshua Oiro, Teddy Brian Odhiambo, Brian Mwasi, Danson Koske, Prachi Mehta, Margaret Ndisha

Palladium Group

Introduction
Kenya's Ministry of Health (MOH) conducts national ART cohort analysis annually to determine outcomes of ART patients. Previously, analysis was conducted from paper records; the number of records used was low, incomplete, not nationally representative and manual data extraction and merging, was tedious and time consuming.

Methods
To increase the number of and representativeness of the national cohort analysis and simplify the collection, and analysis and dissemination, the Data Warehouse Application Programming Interface (DWAPI) was developed to simplify data extraction and transmission, the Data warehouse (DWH) repository and analytics to simplify cohort analysis and (DWH) portal to simplify dissemination of results.

Results
DWAPI implementation simplified DWH uploads contributing to increased number of new EMR facility uploads to DWH from 315 in 2015 to 826 in 2018. The number of records in the DWH increased from 663,700 in January 2015 to 1,423,897 records in January 2018. The records available in the DWH for 12-month cohort analysis increased from 24,000 in 2012, 49,865 in 2014 and 88,780 in 2015 and 95,033 for 2018.
The DWH repository automates cohort analysis simplifying it compared manual systems. The DWH portal has increased access to the cohort analysis results from 15 users in 2015 to 167 from 2018

Conclusion
The number of records for cohort analysis increased as a result of DWAPI implementation. Interactive analytics have automated cohort analytics and the DWH access portal has increased access to ART cohort outcome reports significantly. We recommend sensitization of stakeholders on use of information systems for monitoring treatment outcomes.

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Evidence based planning and budgeting for sustained epidemic control

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[1]Tupime Kaunti Project
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Introduction

Kenya's Public Finance Management Act 2012 requires that all government entities submit a plan to facilitate resource allocation and disbursement of funds. Over the last five years under the devolved systems, the county health sector has developed and submitted Annual Work plans to ensure that budgets are allocated. However, the planning process has not been aligned to the Medium-Term Expenditure Framework (MTEF) cycle. Tupime Kaunti project conducted a baseline assessment for Measurement, Learning and Accountability in March 2017 in: Kisumu, Migori, Homabay, Kisii, Vihiga, Kakamega, Bungoma and Busia counties on Measurement Learning and Accountability. A key finding from the assessment was that Annual Work Plans were a formality since the budgets allocated to the ministry proved inadequate to addressing the key priorities. The project established that with plans developed outside the budget cycle, minimal consideration was given to actual county health priorities and their equivalent budgets.

Objective

To improve county planning and budgeting process for sustained epidemic control

Intervention

To address this gap, USAID's Tupime Kaunti project facilitated a training on planning and policy formulation focusing on the MTEF cycle to a County Leadership Development and Governance group. MTEF cycle spells out the timelines for the county planning and budgeting process. Since the training, the LDG group steered the counties in utilizing information from the various information systems (DHIS2, EID VL database, KNBS, IDSR) as detailed in the key county strategic documents. As a result, the LDG with involvement of department of planning and other health stakeholders generated: Annual Performance Reports & Plans, Sector Working group reports and Annual Work Plans that key strategic documents in the budgeting and planning process within the set timelines.

Lesson learnt from the implementation

Capacity building of county health leadership on MTEF is critical in ensuring county led planning and budgeting process. Involvement of the county planning department and alignment with MTEF cycle is important in ensuring that the budget allocated to the health department is based on its priorities.

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Leadership Development and Governance Groups Model: A catalyst to strengthening Measurement Learning and Accountability Systems

Joyce Nyaboga, Hesbon Ooko, Sam Wangila, Lillian Mageto

USAID- Tupime Kaunti Project

Introduction
The critical role of leadership and governance in the health systems has been well documented over years and is recognised as one of the health systems blocks by World Health Organization. While many interventions have focused on the role of leadership in the health systems, there has been minimum attention to the influence of leadership in Monitoring and Evaluation (M&E) and health information system strengthening. In particular, integration of the numerous leadership teams outside the departments of health whose functions require reliance on M&E outputs for decision making on health resources and performance has not been fully realized. A measurement learning and accountability (MLA) assessment conducted in March 2017 in eight counties namely: Busia, Bungoma, Homa Bay, Kakamega, Kisumu, Kisii, Migori and Vihiga documented gaps in leadership and management impeding MLA strengthening. These gaps included: strategic documents existed but were rarely utilized or reviewed and aligned to strategic documents such as the County Integrated Development Plan, the County Health Sector Strategic Plans and the Monitoring and Evaluation Plan. Further, the leadership teams had minimal knowledge on M&E.

Objectives:
To address these gaps, the USAID Tupime Kaunti project developed terms of reference to form and strengthen Leadership Development and Governance (LDG) groups with a view to coordinate and strengthen the MLA systems and increase the use of data for data for decision making.

Interventions
The LDG groups were trained on leadership and governance as well as in monitoring and evaluation, use of data for decision making and how to formulate policies. A maturity model was developed to guide and track progression of the LDG groups towards maturity.

Lessons Learnt:
The LDG groups have been instrumental in coordinating policy reviews and evaluations internally – a function that initially relied on external consultants. Through the LDGs, there is increased appreciation by the leadership teams on the role of M&E and some of these counties being able to prioritize MLA interventions in their strategic documents and increased ownership of county processes including policies, data analyses and decision making. Further the leadership teams from department of planning and treasury have confirmed to have a better understanding of the health needs and have more interest on the reports being generated.

Conclusion:
The LDG group approach offers an innovative and sustainable capacity strengthening model for institutionalizing MLA.

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Pharmacovigilance Case Study: Medicines Control Authority of Zimbabwe - Electronic Reporting

Rodney E. Onyango

IntelliSOFT Kenya, 2018

Background

Pharmacovigilance (PV) is defined as the science and activities relating to the detection, assessment, understanding and prevention of adverse effects or any other drug-related problem (WHO, 2018). The Medicines Control Authority of Zimbabwe (MCAZ) is an agency of the Government of Zimbabwe responsible for protecting human and animal health by ensuring that accessible medicines, allied substances and medical devices are safe, effective and of good quality through enforcement of relevant standards by manufacturers and distributors. In a bid to ensure better health and to effectively protect the public, the MCAZ created a portal to allow for easier reporting by the public and health professionals on adverse drug reactions and adverse events following immunizations.

Objectives

The objective of the electronic reporting is to: (1) Allow for easy reporting of adverse drug reactions by the public and health professionals, (2) Improve process of reporting by providing real time feedback to reporters on the process of their submissions, and (3) allow for easier reporting and data reporting on incidents related to drug reactions.

Case Presentation

Currently the public has to manually submit reports about adverse drug reaction or adverse events following immunization. It is difficult to monitor the progress of a submission once it has been submitted and the manual process makes it difficult for individuals not closely located the reporting authority (MCAZ). These factors can discourage the public from making submissions as they may view the effort required and ensuing processes there after tedious. Using the online portal, the MCAZ aims to reduce the effort of submitting reports and provide continuous feedback to the reporter via emails and notifications on the system and also improve their reporting to the World Health Organization.

Using the advantage of an online system the manual form was converted to an online page coupled with the advantage of form validation and dictionary preloading that can be applied before submission to help reduce human errors. Upon submission, communication between the reporter and the MCAZ would be maintained via email and in system notification. Once a submission has been reviewed and a decision reached, this would be communicated back to the reporter and the report can then be submitted to the World Health Organization using the provided Application Program Interface where need be.

Conclusion

The online portal will serve to reduce the cost of reporting on the part of the public, this is due to the fact that the system is always available online with the option for offline using either the mobile or desktop version. It seeks to also improve reporting on the part of the Medicines Control Authority of Zimbabwe given that the data will be validated and reviewed maintaining copies of the original for reference. The portal is not yet live and as such results can only be measured against the existing tests that have currently be run, this however have proved that the system will significantly improve the reporting process for the Medicines Control Authority of Zimbabwe.

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Data security and privacy guidelines: Building the ark before floods

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Introduction: Digital information systems hold promise to increase access to healthcare, improve quality of care, and decrease health system costs. Weaknesses within health systems and their data management processes make them vulnerable to cybersecurity threats. LMICs are just now beginning to create the necessary guidelines and frameworks for data security and privacy, and these efforts would benefit from global guidance tailored to their context. To meet this need, MEASURE Evaluation, funded by the United States Agency for International Development, developed mHealth guidelines for data security, privacy, and confidentiality for countries and programs.

Purpose: To share the mHealth data security and privacy guidelines with countries and programs

Methods: We assessed current data security, privacy, and confidentiality practices in LMICs through a literature review and expert advice; and we conducted key informant interviews and focus group discussions in Kenya and Tanzania. We used this information, along with additional input from digital health and data ethics experts, to write mHealth privacy and confidentiality guidelines.

Results: These guidelines cover national and organizational policies and user behavior—all of which are important to the implementation of secure technology. The guidelines also delve into the specifics of mHealth hardware, software, and communication channels between devices and other systems.

Conclusion: Data security and privacy must be elevated to the forefront in the design, development, and deployment of digital information systems in LMICs. These mHealth guidelines provide an important reference resource for the countries and programs seeking to design and implement mHealth programs or digital health programs, in general.

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The Impact of an SMS-based Reporting System for Monitoring National Stock-out of HIV Commodities at Public Health Facilities: A Case of Uganda.

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Background: Stock-out of HIV commodities such as anti-retroviral therapy (ARV) and test-kits may prevent countries from reaching the 90-90-90 targets. To achieve the targets, Uganda has implemented guidelines which endorse the test and treat strategy. With support from the Center for Disease Control and Prevention and Makerere University School of Public Health, the Ministry of Health (MoH) implemented a reporting system based on short message service (SMS) of data on two HIV commodity indicators which are sent by health workers through their mobile phones to the central server at MoH. The reported stock-out data is used to trigger prompt action to deliver the commodities. We describe the impact of implementing a SMS-based reporting system for monitoring national stock-out of HIV commodities at public health facilities in Uganda.

Methods: To determine the impact of the SMS-based reporting system, we performed a retrospective cohort analysis of data on stock-outs of HIV test-kits and ARVs reported from 1,700 health facilities across the country. We compared stock-out levels reported in 2014 (baseline) to those reported in 2015, after complete operationalization of the system.

Results: The proportion of health facilities reporting stock-outs of HIV test-kits reduced from 22.5% in 2014 to 16.4% in 2015. Similarly, the proportion of health facilities reporting stock outs of ARVs reduced from 46.1% in 2014 to 40.9% in 2015.

Conclusion: The SMS-based reporting system for stock-out of HIV commodities led to a considerable reduction of stock-outs of HIV test-kits and ARVs in public health facilities in Uganda. This low cost-effective innovation should be adopted by other countries in Sub-Saharan Africa for effective monitoring of HIV commodities.

Keywords: Key words: SMS-based system, HIV commodities, Uganda

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Patients' use of emergency medical card to enhance continuity of care at the point of care

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Introduction: Discontinuity of care due to poor communication of patient health information among healthcare providers (HCPs) is a major efficiency and patient safety concern. Patients often see multiple HCPs and during each visit, the patient's core health information is required for appropriate decision making. Complex and fragmented healthcare systems hamper provision of effective care where it is needed most. In most instances, continuity of care (CoC) is rarely considered during referral, transfer, or discharge of patients from one caregiver to another. The dearth of pertinent current and historical health information at the point of care may lead to medical errors, adverse events, and poor outcomes. To address these important problems, a study implemented an automated system ("CoC system") compliant with an American Standard for Testing and Materials' (ASTM) continuity of care record (CCR) standard (E2369-05)—to enable patients to view, add and modify their information in a personal database and create an emergency medical card (EMC). The CCR standard facilitates the creation of electronic summaries of patient health—to improve the quality of health care and to reduce medical errors by making current information readily available to healthcare providers. The standard contains information such as document identification, patient identifiers, insurance, healthcare status, advance directives, care documentation, care plans, and providers.

Objective: The objective was to determine whether or not patients actually used EMCs for the previously intended purpose for which they had created them using the CoC system.

Methods: This was a prospective, observational, and descriptive study, which surveyed patients at 36 outpatient clinics in the Intermountain Healthcare network, Salt Lake City, Utah, USA. At the end of 6 months of the CoC system use (between October 2008 and June 2009), patient users (aged between 18 and 90 years) were surveyed. At the EMC creation (entry) stage, patients were prompted with a survey to indicate the intended use of the EMC they created. Upon using the EMC at provider visits, patients entered visit's data into the CoC system—to update and print a new EMC—to use in next hospital visit. At this (exit) stage, another survey asked patients whether or not they used the previous EMC for the earlier intended purpose.

Results: One hundred and thirty-three patients used the CCR application to create an EMC. All the 133 users were surveyed and all responded to the survey. However, 32 users were excluded from the analysis because they had not used their EMCs. The remaining 101 (76%) who all found the EMC useful in CoC, only 30 (30.0%) used the EMC for the previously intended purpose, at the time of creation—and were included in the analysis. Of the 30 patients, 24 (80.0%) patients stored EMC for use during any emergencies, 17 (56.7%) for personal use, 4 (13.3%) to update records, 3 (10.0%) to correct data errors, and 1 (3.3%) just for review—overlaps exist among these EMC use categories.

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Conclusions: A significant majority of patients reported that the EMCs was useful in enhancing continuity of care, and also primarily intended to store EMCs for use during any emergencies or for personal use. Only about a third of patients used EMCs for the previously intended purpose for which they had created them. Patients were able to use the data to update and correct errors in their records, making them an important source of quality control for their information in the healthcare-provider-maintained electronic medical records.

Keywords: Continuity of Care, Emergency Medical Card, Electronic Medical Record, Continuity of Care Record Standard

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Best Practices for implementation of EMRs at the primary care level

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1 Introduction

The use and adoption of information technology (IT)-based applications in healthcare and particularly electronic medical records (EMRs) has been on the rise over the past two decades. Both primary and secondary healthcare facilities, that traditionally recorded patient records manually, have embraced EMRs for recording patient data and overall patient care management. Nowadays, it is almost hard to imagine healthcare without IT-based applications for the collection, analysis, storage and use of patient clinical information. This is in part because IT has been recognized as an "enabler", in addressing world's most pressing challenges.

Several studies have shown that EMR interventions have led to in improved quality of care provided, reduced medication errors and improved communication and interaction between patients and the care providers, which in turn results to improved patient outcomes and strengthened public health system.

2 Objective of the intervention

This paper highlights best practices that can be adopted to increase the adoption, utilization and usability of EMRs at the primary care level.

3 Lessons Learned

As with other technological innovations, adoption of interventions such as the EMR take time to materialize. However, if the following factors are considered, then adoption becomes rather much easier.

3.1 Considerations at system level

- Central Data Repository
  Establish a central repository that will allow sub-county access to data for decision making, perform data quality checks and retrieve reports during supportive supervision and conduct disease surveillance. The central repository will also help in establishing a client registry for the sub-county/ county which in turn helps determine the correct baseline population.
- In-built dashboards for data analysis and use
  Incorporate dashboards in the EMR to support data analysis, interpretation and use at the facility level to strengthen their decision-making capacity in responding to matters of public health concern.
- Comprehensive modules
  Ensure the EMR automates all service points at primary care facility. The EMR should contain modules for outpatient department (OPD), Laboratory, Pharmacy, Inventory management,

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Immunization, Family Planning, Antenatal Care (ANC), Child Wellness Clinic (CWC) and Maternity modules. The EMR should generate reports for all the modules.

- EMR should have in-built data quality assurance & controls mechanism
- Integration with DHIS2 such that reports generated by EMR are automatically submitted to DHIS2. Integrate patient data across facilities within a specified geographical location (e.g. ward, district etc.) and especially if the facilities are using the same EMR.
- Have local-based developers to address change requests made.

3.2 Considerations at end user level

- User engagement in requirements gathering for additional system features and validate and test with users.
- EMR should promote timeliness and completeness KPIs for HMIS reporting
- Provide continuous refresher training and prompt on-job-training for new staff
- Provide prompt technical support
- Establish ad-hoc communication channels such as WhatsApp groups to serve as feedback forum.

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Using DHIS2 as an Integrated Quality Assessment Tool

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In the light of the new global paradigm of universal health coverage (UHC) the issue of access to health care services at health facilities that meet set quality standards is now receiving closer attention from national and county governments, and international partners. The early development and adoption of digital tools plays a crucial role in a successful implementation of a quality assurance (QA) system.

The GIZ Health Sector Programme in Kenya (GIZ-HSP) has supported her Kenyan partner counties and health facilities for many years in setting up and training of QA methodologies. With the official launch of the new version of the Kenyan Quality Model for Health (KQMH), the framework was established for developing a web-based quality assessment tool for health care facilities. A strategic decision to integrate the KQMH assessment tool into the national DHIS2 platform was made at the onset this initiative in order to maximise the use of existing structures and thus to reduce implementation costs and to assure the sustainability of the solution.

Comparing this chosen approach to the classic approaches in similar settings, that aim at developing a completely new software stack reveals a number of advantages that can be directly attributed to generic software packages under OS licenses. These include, use of a widely familiar platform (DHIS2), lower cost of implementation which only required customization of DHIS2, and assured sustainability due to the fact that it is a government supported platform. A high degree of ownership was attained by exclusively involving experts from the local DHIS2 community.

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Supporting Health Facilities to Use DHIS2 Data

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The decentralised use and analysis of quality data is a crucial enabler for effective health service management at health facility level. The use of information by data collectors enhances the quality of the data. Since 2012, the Kenyan DHIS2 platform has achieved a remarkable reporting completeness for core service statistics. However, an assessment of partner facilities by the Kenyan GIZ Health Sector Programme revealed that DHIS2 is almost exclusively used for upward reporting and health facility staff lacks analytical training.

An intensive 6-day training curriculum was set up for health record officers (HRIOs) at facility and (sub) county level. Managers from facilities and county health teams were encouraged to take ownership by defining 10 key performance indicators from real annual work plans as a basis for analysis and by providing technical inputs to the training results..

Areas of concern were data quality, inadequate access to DHIS2 software and weak data demand by managers. Technical issues and inconsistencies of the DHIS2 instance hinder data analysis for untrained users. Handling these obstacles was the major focus of the training, which was well received by all participants.

As a result, the HRIOs gained skills in all aspects of the information cycle, managers saw the value of routine DHIS2 data and discussions about data were initiated between stakeholders. It is recommended to further develop a decentralised culture of information use for Kenya through development of a “DHIS2 driver's license” course for HRIOs, technical revision of the DHIS2 instance and institutionalisation of discussions about data at all levels.

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openIMIS - A Generic Open Source Tool to Manage the Health Financing Bit of Universal Health Coverage

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In the light of the new global paradigm of universal health coverage (UHC), the issue around the financing of health care services is receiving new and strong recognition by international partners and national governments. The early development and adoption of digital tools plays a crucial role in a successful implementation of UHC strategies.

The openIMIS Initiative was set up as a joint initiative by the Swiss and the German Development Cooperations to establish a community of users and developers around an Open Source software for Insurance Management Information Systems (IMIS) and to provide for a seamless integration into the activities of related communities from the global digital health ecosystem such as the Open Health Information Exchange (OpenHIE) community.

The activities build upon an existing software developed by the Swiss Tropical and Public Health Institute (SwissTPH) in cooperation with the Micro Insurance Academy (MIA) and developers from Exact Software. It is currently being used for various health financing schemes in Tanzania, Nepal and Cameroon. The IMIS already successfully covers core business processes such as enrollment and management of beneficiaries, claims processing and client feedback mechanisms in a web-based platform.

As a result, IMIS will be transformed to openIMIS in order to make the system customizable to specific processes and financing schemes of the actual and potentially new users. The package will also be migrated from a proprietary software stack to a pure OS architecture. The initiative will build and coordinate the community of practice and develop guidelines, standard operating procedures and training materials.

Keywords: openIMIS, Open Source Software, Univeral Health Coverage, Health Financing, Health Insurance

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Strengthening Supply Chain Management Systems for HIV Commodities: A Case Study of Real Time ARV Stock Status (RASS) Monitoring System in Uganda.

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Introduction: Due to frequent stock outs of HIV commodities in the country, the increasing number of people living with HIV/AIDS accessing Antiretroviral therapy (ART) care and to achieve UNAIDS goals that suggest that controlling the HIV epidemic requires strong linkages across a 'cascade' of prevention, testing, and treatment services hence demanding a mechanism to effectively monitor the cascade by providing access to timely and accurate data, there was need to develop a functional real-time ARV Stock Status (RASS) monitoring system and dashboard.

Objective: To provide real-time intelligent data and actionable information on antiretroviral (ARV) and Rapid Test Kit supplies (HIV commodities) while integrating it with data from other Information Systems for enhanced decision making as well as support evidence-based actions in supply chain planning and improve the performance of the HIV cascade in real-time.

Implementation: RASS is currently implemented in 361 Health facilities in 25 districts. The facilities report stock status and receipt for HIV commodities on a weekly basis through a Short Text Message via a mobile handset to the RASS System that interoperates with the national electronic Health Management Information System and other facility level supply chain systems.

Lessons Learned: With continuous awareness and increased coverage, RASS has the potential to improve the HIV treatment cascade and ensure availability of ARV Drugs and Rapid Test Kits as well as increase its utility and improve access to the HIV commodities. RASS can impact the quality of orders made and track the consumption and distribution of HIV Commodities.

Keywords: Dashboards, HIV Cascade, Stock Status, Real-time, HIV Commodities

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Adolescent Pregnancy Data Audit Assessment, the Case of Bobasi Sub-County – Kisii County

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Background
Tupime Kaunti project is supporting 8 counties in Nyanza and Western region. Kisii county is partnering with the project to support health systems strengthening interventions geared towards improving quality of data to enhance evidenced based programming for Reproductive, Maternal, Newborn, Child and Adolescent Health (RMNCAH). Availability of quality data for informed decisions is still a challenge in regards to adolescent health. On a monthly basis, data is collected, collated into summaries at health facilities and then uploaded to the District Health Information System (DHIS2) by the Sub County Health Records and Information Officer (SCHRIO). However, there are inconsistencies between the data available in the primary reporting tools (registers), summary tools and in the national health reporting system - DHIS2. This created a major gap in adolescent pregnancy data quality. To address this discrepancy, Kisii county conducted a pilot Data Quality Audit (DQA) on selected RMNCAH data in Bobasi Sub-County.

Objectives
The assessment aimed to verify the data from primary data tools (registers) for select indicators against summary data in MOH 711 and DHIS2 data (software). The exercise was to evaluate the following data quality dimensions: accuracy, completeness and timeliness.

Interventions
In 2018 February, an RMNCAH data review was conducted in Kisii county. Among the challenges identified was inconsistency in data quality of adolescent pregnancies reported in the county. After the data review, Bobasi sub-county did a pilot DQA for some selected RMNCAH indicators which included adolescent pregnancies for January to March 2017 in 19 out of the 29 health facilities. The activity was spear headed by the county with support from a development partner. Following the DQA exercise, major data discrepancies were found in the number of adolescent pregnancies. Upon comparison of data from the source document MOH 405, summary tool MOH 711 and DHIS 2, adolescent pregnancies were 228, 478 and 483 respectively. This showed 112% increase of adolescent pregnancies data in the DHIS 2 compared to the primary data source tool (MOH 405). As a result, the Sub-county reproductive health coordinator and the SCHRIO disseminated the results to all health facility in-charges. A sensitization on data collection using MOH 405 was done for all maternal and child health department health workers.

Lessons learnt
The high adolescent pregnancies recorded in DHIS 2 for Kisii county and probably the Western and Nyanza region could be mainly due to poor data quality at the point of summary into MOH 711 and entry into the DHIS 2. It is important for DQAs for adolescent pregnancies to be done, and monthly data quality assessment before data is uploaded into DHIS 2.

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Technology Enhanced Decentralized Health Information System Improving Population Health: Experience from Lesotho's National Roll Out of Web-Based Data Management and Reporting System

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Introduction: Limited availability of clean and collated routinely collected data at decentralized levels of the health system hamper timely and targeted program planning and response critical to improve population health. In Lesotho, where 25% of adults 15-49 are HIV- infected, the Ministry of Health (MOH) and ICAP at Columbia University, through PEPFAR funding, established a national, integrated web-based health information system (HIS) on a DHIS2 platform (https://www.dhis2.org/). The HIS is designed to bring data to decision- makers closer to where patient encounters occur, allowing them to examine patterns in patient population and service delivery.

Intervention: Between 2015 and 2018, equipment and infrastructure gaps at all 10 district health offices and 177 facilities were addressed; 500 MOH staff at central, district and facility levels were trained in entering and using data; historical data (2008-2014) from 9 health programs were cleaned and imported; and the MOH master facility list was reconciled with unique facility identifiers and accurate GPS coordinates. With 81% of facilities submitting monthly reports directly via HIS, improvements have been observed between October 2016 and March 2018 in completeness (78% to 100%) and timeliness (49% to 80%).

Lessons Learned: HIV program managers at all levels are able to track implementation of national strategies, e.g. Test and Treat in 2016; identify and address gaps in care, e.g. HIV- exposed infants; and target poor performing facilities for support. MOH plans to expand HIS coverage to all remaining health facilities and continue to improve quality and use of data through intensive review and feedback cycles.

Keywords: HMIS; decentralization, data use, evidence-based decision making

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In-County university model for sustaining health information systems strengthening

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International development is in a transition period where country ownership and capacity development are of focus to create sustainable partnerships and develop local solutions. This is in contrast to situations where development partners use foreign-owned country-based organizations to offer support. This spirit of localisation of development work is echoed in the Accra agenda for Action 2008 and USAID Forward (2010-2016). This paper discusses an approach spearheaded by a USAID funded activity- HealthIT, where local public universities through faculty, staff and students provide support to county governments in the field of Health. With the need to build technical and organisation capacity at the county level, HealthIT with support from Ministry of Health, is piloting an in-county university support model to strengthen Health Information Systems and build capacity in Health Information Systems Operations Research in four counties in Western Kenya. This approach is intended to contribute to the sustainability of HIS initiatives within the counties through affordable proximate skilled technical support. Sustainability and county ownership of the county- university model greatly relies on participation of different stakeholders such as universities, CHMTs, county Monitoring and evaluation (M&E) Technical Working Groups (TWGs), other implementing partners in the planning and implementation of county work plans. Positioning the four in-county universities as HIS technical support partners is the continued endeavour by HealthIT through HIS technical capacity building and institutionalisation of the partnership model. The county-university model provides a great opportunity for development partners in all sectors, to tap into local public institutions to develop local solutions because these institutions will have the requisite skills, county buy-in and a continuous pool of resources.

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Online learning as a measure to supplement face to face training of healthcare workers in health information systems

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Training of healthcare workers to build their capacity to use Health Information Systems (HIS), both to capture data into systems as required, and to access the generated information as appropriate, while ensuring the security of both data and systems is a key factor in determining not only the quality of data but also the use of information to inform policy and for decision making. For HealthIT, a three year project funded by USAID and based at the University of Nairobi's School of Computing and Informatics, and the Ministry of Health (MoH)'s Division of Monitoring and Evaluation Research Development and Health Informatics (DivMERDHI), one of the key outcomes is to work with various cadres of healthcare workers to design online content according to established learning needs of the trainees, seek recognition by the boards and associations of the health workers, and launch the courses. The greatest advantage of this supplementary mode of learning is that the trainees who are not able to attend face to face trainings will have an opportunity to take courses that offer certificates that are recognized and that contribute to the Continuing Professional Development (CPD) points for the workers. At the same time, the trainees will be able to refer to the content at any time as it will be available. They will be able to study the courses effectively as they are designed in a modular form and it is rich, with multiple types of media used in rendering the content. In addition, online learning does not suffer from space constraints and also consumes less in terms of resources required for mounting the trainings. Therefore, for MoH that has a running need to continue improving and refreshing the capacity of its' workforce to use HIS, hopefully this can make HIS training sustainable as the greater chunk of the expenses will be those for occasional updating the course content.

HealthIT has so far established learning needs of the learners. The appropriate Learning Management System for use has also systematically selected. The content for two courses has been converted into the modular and rich form for online learning that is suitable for busy adult learners. There has been a lot of progress towards accreditation by the boards of health workers so that the certificates can be recognized and can contribute to CPD. The Health Record Information Officers (HRIOs) and Clinical Officers (Cos) have participated in validation and sampling of the courses.

Going forward, the courses need to be rolled out for actual studying by the learners that leads to certification. Then, practical sessions for assessing technical skills will be held in universities close to where the health workers are placed. There will also be need to review the guidelines for online learning in order to keep improving its' effectiveness as a mode of learning that supplements face to face training. There is also need to tie down accreditation with major boards and associations for recognition of the certificates offered on completion of the courses.

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Lessons from piloting an electronic dispensing and inventory management system in Malawi

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Background: The availability of medical supplies is one of the indicators of the quality of health service delivery [1]. Lack of medical supplies such as essential medicines can often have catastrophic results on patient health. Similarly, excess availability of medical supplies is undesirable as it often leads to wastage [2]. To ensure continued reasonable availability of medical supplies, access to timely and accurate information about current stock levels and consumption trends for each medical item is required. To this end, we developed the electronic Dispensing and Inventory Management system (eDIM), a software application that records quantities of each medical item and uses electronic dispensing to maintain accurate stock levels for each item. We assessed the feasibility of successfully implementing such a system in a low-resource setting by piloting it at Daeyang Luke Hospital (DLH) in Malawi.

Methods: The pharmacy at DLH has a dispensary, which maintains a sizeable quantity of all medications and a bulk storeroom, where the rest of the hospital's medication stock is kept. A touchscreen clinical workstation (TCW) was deployed in the dispensary to facilitate dispensing of medications to patients. Another TCW was deployed in the bulk storeroom for recording of stock receipts and issuing of medication to the dispensary and other departments of the hospital. Each item in the DLH pharmacy was assigned a unique identifier at the start of the pilot or on receipt following the start of the pilot. The identifier was affixed to the item's container in the form of a barcode label and was linked to the item's record which also had the item's name, expiry date, the quantity received, and current quantity as attributes. To dispense an item, the pharmacist scans the patient identifier barcode which brings up the patient's medication history at that health facility [3]. From this page the pharmacist can dispense any item by scanning the item's barcode and entering the prescription directions which determine the quantity to be dispensed. Upon completion, a label was printed with the patient's name, prescription instructions and the dispensation date of the medication. The stock current quantity for that item was also updated to reflect the most recent dispensation.

Results: Our ongoing pilot implementation has provided us with several lessons for future implementation and improvement of eDIM:

1. Reduction in time spent on reporting and physical inventory are the easiest gains for electronic inventory management.
2. Pharmacists employ several workarounds that they have developed over time when documenting receipts and issues of inventory items. These workarounds must be considered when designing interventions to improve inventory management processes.
3. Substantial effort is required to record all items during initial implementation and subsequent bulk item receipts. Improving this process may increase the probability of successful implementation of electronic inventory management systems.
4. Electronic prescribing is necessary to reduce the amount of information entered by pharmacists for each dispensation. In the absence of electronic prescribing, the average service time for each patient may increase leading to frustration on the part of pharmacists.

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5. Coupling a patient record to a dispensation provides the best audit trail for medical items. If the entire patient population isn't registered or a patient registration system isn't integrated, anonymous dispensing can be used at the cost of a clear audit trail and an electronic patient medication history.
6. Standard medication vocabularies are needed to reduce the effort spent on maintaining medicine lists.

Conclusion: Despite its obvious benefits, several challenges remain in implementing systems like eDIM in low-resource settings. Buy-in from hospital management and pharmacists, adequate staffing levels, and integration with other existing systems such as patient registration and prescription order entry are necessary for the success of these implementations.

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Moving Towards Standards-based, Interoperable Human Resources Information Systems (HRIS) in Sub-Saharan Africa

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Background: Human Resources for Health (HRH) is a key determinant of success or failure of healthcare delivery. HRH strategies recognize Human Resources Information System (HRIS) as an essential source of data for evidence-based decisions to address HRH challenges such as mal-distribution, low retention rates and poor continuing professional development, all of which negatively impact health programs in sub-Saharan Africa. WHO recommends the use of the Minimum Data Set (MDS) to standardize electronic HRH registries to enable health workforce data interoperability and promote data use.

Methods: Kenya is an early adopter of the MDS. Interoperability between two sub-systems, namely, rHRIS (http://emorykenya.org), which tracks pre-service education and registration, and the iHRIS (http://ihris.org), which tracks deployment, is in progress based on the MDS and other open standards for information exchange. Automated data exchange is achieved via scheduled cron jobs. We used the US President's Emergency Plan for AIDS Relief (PEPFAR) HRIS Assessment Framework (HAF) based on the Capability Maturity Model (score 1 – 5) to assess maturity of HRIS capacities in 2015 and 2016.

Results: Initial results from the ongoing HRIS data modeling and systems re-design showed ability to exchange information on pre-service education, registration status (rHRIS) and deployment (iHRIS) to create health worker profiles. Kenya reported improved HAF scores: 3 to 4 (Use of standards) and 1 to 2 (Interoperability) between 2015 and 2016.

Conclusion: Systems development based on standards has potential to achieve HRIS sub-systems interoperability and improve data use for decision making. Routine objective assessments are needed to measure progress and identify gaps.

Keywords: Human Resources for Health, Human Resources for Health Information System, Interoperability, Standards

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Evaluating the Use of Biometric Technologies as an Emerging Technology in Health Information Systems Management

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To achieve Sustainable Development Goal (SDG) 3, a robust patient identification system is required for efficient and effective delivery of health services and public health management. Unique identification helps to improve the quality of care, patient access, insurance coverage and data collection[1]. Despite the potential benefits Unique Patient Identification (UPI) presents, debates continue on real or perceived fears around patients privacy and security risks[2]. The debates seem to be blind to the potential improved health outcomes and cost effective use of scarce resources. With a UPI, accurate information is attached to the right patient, data access is timely, redundant tests are eliminated or minimized, medical errors caused wrong identification reduced; and health information exchange becomes easier[3]. Biometrics, an emerging technology in unique identification is increasingly being used by companies and Governments for identification, personalized experiences or surveillance[4]. We evaluate the potential benefits of biometric technologies in Health Information Systems Management.

Keywords: Unique Identification, Biometrics, Health Outcomes

1 Introduction

The current lack of an accurate UPI system in most healthcare systems means that healthcare providers typically rely on a patient's name and date of birth for identification, neither of this is always unique to one individual. Healthcare providers are constantly faced with the challenge of properly identifying their patients, the possibility of duplicate patient records in Health Information System (HIS) isn't far fetched[5].

Duplicate patient records could lead to revenue loss in a healthcare system, as records don't match clients served. Health metrics maybe skewed by the duplicate records influencing healthcare compliance and patients outcomes[6]. It's becoming a big concern the number of duplicates in existing HIS and the threat it poses to healthcare provision, outcomes and accounting for resources[789].

Errors in identifying patients could disrupt healthcare and harm patients[10]. Failure to correctly identify patients results in medical errors including wrong tests, medical procedures and treatment being administered[11]. In some cases, infants have been discharged to wrong families due to mis-identification in the healthcare system[12]. Sadly, medical errors due to the inability to correctly identify patients is a leading cause of death[13].

Fraud in medical claims poses one of the biggest threat to Universal Health Coverage (UHC), stolen patient details have been used to obtain or bill for medical goods or services[14]. The healthcare system is vulnerable to fraud mostly due to the current limitation in the patient unique identification and verification process, this has led to the loss of scarce and much needed resources[15].

Treatment follow-up requires that a patient is correctly identified in cascade of care at one or multiple facilities to improve their health outcomes[16]. Matching of a patient to an intended treatment is an activity that is performed routinely in healthcare settings[17]. A universal patient identification system also makes it possible to link medical records and facilitate data exchange[18]. A good health information system should

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enable a patient conveniently access care at multiple facilities, such a system could provide healthcare providers with sufficient patient treatment history for accurate and informed medical decisions.

2 Unique identification in healthcare

Current health systems face a number of challenges to effectively identify clients accessing care, this is due to lack of universal and tamper-proof identification mechanisms. Even where systems are digitalized, they are mostly stand-alone, greatly impacting data sharing, aggregation and monitoring[1].

Patient identification is a bigger operational challenge in resource-limited settings, already the healthcare providers working hard to ensure safety and quality of care with minimal resources [1920]. The identification challenge is due to poor national person identification systems, inefficient identification procedures and fraudulent practices in the health facilities[21].

There exists a great need for innovation to the patient unique identification challenge[22]. Technologies facilitating patient unique identification would enhance patient safety and reduce the overall cost of healthcare delivery[2324].

The paper now briefly discusses challenges faced in the healthcare system due to lack of unique identification system. Later, biometrics technology is discussed as a secure, reliable facilitator and enabler of patient unique identification in healthcare system.

2.1 Data Duplication

Duplicate patient records occur when a single patient is associated with more than one record, pertinent patient information is fragmented between two or more records[25]. Duplication of medical records leads to unnecessary tests, delayed diagnosis and wrong treatment[26]. It's also a big financial burden to the healthcare system[27].

It's estimated that duplicate patient records cost every patient $20 to $96, more as costs are incurred due to repeat tests and delayed treatment[2829]. To the health facilities, duplicates lead to inefficiencies such as clinical errors and patients dissatisfied[30].

2.2 Medical Errors

Failure to associate each patient with their correct medical records due to mis-identification could lead to medical errors resulting in patient harm or even death[31]. Most times, at least two people are affected, one gets the wrong treatment and the other misses much needed care[32].

Early 2018 in Kenya, one patient needed a surgery due to a blood clot on the brain and the other patient needed treatment for a swelling. Due to mis-identification, the brain clot patient missed their surgery and patient with a swelling underwent a wrong risky and painful brain surgery[3334]. A reliable and secure identification system could have prevented the occurrence.

2.3 Fraud in Healthcare Systems

Fraud is a big problem in health systems; it's caused by billing for services not rendered, misrepresenting dates, location or provider, over utilization of services and false issuance of drugs[35]. Healthcare fraud is at most times caused by inability to uniquely identify patients in a tamper-proof manner and link them to each health facility encounter[36].

In one Country in 2018, 600 were charged with healthcare fraud amounting to about $ 2 billion[37]. In another setting, an Organization was forced to refund millions of dollars of false-billing, observation services and inflated claims[38]. There is a need to employ an identity proofing and authentication system of the highest confidence level in healthcare delivery to minimize fraud[39].

2.4 Treatment Follow-up

Adherence to treatment follow-up has a key role in medical surveillance of chronic health conditions and their outcomes[40]. In fact, a number of healthcare systems are working on a personalized follow-up plan based on an individual's healthcare needs[41]. At times, a comprehensive treatment follow-up is a matter of life and death[16].

The World Health Organization (WHO) identifies increased patient retention and follow-up care as one benefit of an effective UPI system[1]. Uniquely identifying patients in the cascade of care could make healthcare high quality and cost-effective as access to services will be uniquely linked at every service delivery point and the patient encounter[3].

3 Biometrics for unique patient identification

Biometrics is the use of a person's unique physical and behavioral characteristics for identifications[42]. A biometrics system can successfully connect an individual to each event unlike Personal Identification Number (PIN) that could be shared or transferred[43]. Biometrics for unique identification in healthcare has a potential to enhance patient safety[44]. Let us briefly interrogate two biometric technologies and their potential impact in healthcare delivery.

3.1 Fingerprint Biometrics

Fingerprint for unique identification is one of the oldest technologies having been in existence for thousands of years. The fingerprint biometrics has successfully worked in the criminal and justice systems[45]. Basically, this technology captures an image then detects and matches similarity from an existing database[46].

Fingerprints for unique identification in healthcare has been implemented in one of the largest health system in the world with great lessons learnt[47]. This technology could ensure "you are who you say you are" in a healthcare setting both as a patient or healthcare provider[48].

3.2 Iris Biometrics

This is contactless biometric system that scans a person's iris and uses this to verify or authenticate an identity[49]. The identification process involves gathering images of the eyes, then a computer system compares the iris patterns with stored images. Iris biometrics prides in accuracy, speed and small storage size[50].

Iris biometrics is slowly being adopted at healthcare settings with great uptake from users[51]. This technology is viewed as "clean" as the patient never touches anything a big issue in a healthcare setting due to infection control[52].

4 Anonymous patient unique identifier

The greatest challenge to an acceptable UPI is the fear of risking a patient's confidentiality and the information security threat that could be caused by a system breach [5354]. As a vital component of a HIS, the discussion around UPI needs a forward-looking approach[55].

A biometrics-based UPI could implement an anonymous patient identifier that protects a patient's Personal Identifiable Information (PII). A health system encrypting and separating PII with encounter data is a great option[5657].

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